1992 WASHINGTON STATE

SALMON AND STEELHEAD STOCK INVENTORY

APPENDIX ONE
PUGET SOUND STOCKS

NORTH PUGET SOUND VOLUME

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
AND
WESTERN WASHINGTON TREATY INDIAN TRIBES

OLYMPIA, WASHINGTON

JUNE, 1994

The Puget Sound Appendix covers 209 of the 435 wild salmon and steelhead stocks identified in Washington State. Because of the amount of information presented, this Appendix is published as a three-volume set: North Puget Sound, South Puget Sound, and Hood Canal and the Strait of Juan de Fuca.

THE TECHNICAL STAFFS OF THE FOLLOWING TRIBES AND TRIBAL ORGANIZATIONS CONTRIBUTED TO THE PREPARATION OF THE NORTH PUGET SOUND VOLUME.

LUMMI TRIBE
NOOKSACK TRIBE
NORTHWEST INDIAN FISHERIES COMMISSION
SAUK-SUIATTLE TRIBE
SKAGIT SYSTEM COOPERATIVE
STILLAGUAMISH TRIBE
SWINOMISH TRIBE
TULALIP TRIBES
UPPER SKAGIT TRIBE

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INTRODUCTION

This appendix volume is the North Puget Sound regional supplement to the *1992 Washington State Salmon and Steelhead Stock Inventory* (SASSI),[1] and provides more detailed information on individual salmon and steelhead stocks identified in the inventory. This information was assembled jointly by the Washington State Departments of Fisheries and Wildlife and the Western Washington Treaty Tribes. The Departments of Fisheries and Wildlife merged to form the Washington Department of Fish and Wildlife early in 1994. The general approach used to develop these appendices is described in the above referenced document.

SASSI documents the results of an initial stock status inventory that is the first step in a statewide effort to maintain and restore wild[2] salmon and steelhead stocks and fisheries. The inventory's intent is to help identify currently available information and to guide future restoration planning and implementation.

The SASSI process inventories **naturally reproducing** stocks of salmon and steelhead regardless of origin (including native, non-native, and mixed parentage). Only those stocks that spawn within Washington State were included. The current status of each stock was rated based primarily on trends in survival rates or population size, but the process did not focus directly on causative factors like habitat loss or overfishing. Stocks with escapement, run-size, and survival levels within normal ranges and not displaying a pattern of chronically low abundance were rated as **Healthy** stocks. Those stocks that currently display low production or survival values were assigned to one of two separate rating categories: **Depressed** stocks or **Critical** stocks, depending on the current condition of the stock. Stocks were also rated as **Unknown** stocks when data limitations did not allow assessment of current status. A rating category for **Extinct** stocks was also included. However, the only extinctions listed in this inventory are those stocks that were thought to exist, based on recent data, but were subsequently found to be extinct. Past extinctions have not been included because SASSI is a **current** resource inventory and the historic information on lost stocks is incomplete and often anecdotal.

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1 SASSI -- Washington Department of Fisheries et al. 1993.

2 The term wild stock as used in this report refers to how fish reproduce, i.e. by spawning and rearing in the natural habitat, regardless of parentage, and does not refer to genetic heritage. The origin (e.g. native, non-native or mixed) and parentage (wild, cultured or composite) of individual stocks are specifically designated in this report where known. This terminology is not intended to diminish the importance of native stocks but rather emphasizes the need to protect a wide range of genetic resources maintained by natural reproduction. The terms natural and wild spawners are used synonymously as are the terms stocks and spawning populations.

Of the 435 total salmon and steelhead stocks identified state-wide, 209 stocks were found in the Puget Sound basin. Of this total, 71 salmon and steelhead stocks are located in the North Puget Sound region, and are the subject of this volume. Table 1 presents a summary of stock status for wild Puget Sound salmon and steelhead.

For a more detailed discussion of the methods used to identify individual stocks and rate current status, see the SASSI summary volume.

Two elements of the 1992 SASSI process are presented in this appendix:
(1) Species Overview Reports for each basin in the Puget Sound region, and
(2) Stock Reports for each individual stock. Any comments or questions regarding this information should be directed to the Washington State Department of Fish and Wildlife in Olympia, Washington.

In this volume of Appendix One, only North Puget Sound stocks are presented. There are two other separate volumes in Appendix One which present information for South Puget Sound and Hood Canal/Strait of Juan de Fuca stocks.

Table 1. Summary of stock status for wild salmon and steelhead stocks in the Puget Sound basin.

	HEALTHY	DEPRESSED	CRITICAL	UNKNOWN	EXTINCT
NORTH PUGET SOUND					
Chinook salmon	3	7	2	3	0
Chum salmon	8	0	0	4	0
Coho salmon	4	3	0	7	0
Pink salmon	5	0	0	2	0
Sockeye salmon	0	0	1	0	0
Steelhead	7	2	1	12	0
71 TOTAL STOCKS	27	12	4	28	0
PERCENT OF TOTAL	38%	17%	6%	39%	0%
SOUTH PUGET SOUND					
Chinook salmon	5	0	1	4	0
Chum salmon	18	0	0	4	1
Coho salmon	8	3	0	0	0
Pink salmon	2	0	0	0	0
Sockeye salmon	0	3	0	0	0
Steelhead	7	1	0	5	0
62 TOTAL STOCKS	40	7	1	13	1
PERCENT OF TOTAL	65%	11%	1.5%	21%	1.5%
HOOD CANAL & STRAIT OF JUAN DE FUCA					
Chinook salmon	2	1	1	0	0
Chum salmon	12	1	2	5	0
Coho salmon	8	10	1	2	0
Pink salmon	2	2	2	0	0
Sockeye salmon	—	—	—	—	—
Steelhead	2	11	0	12	0
76 TOTAL STOCKS	26	25	6	19	0
PERCENT OF TOTAL	34%	33%	8	25%	0%
PUGET SOUND					
209 TOTAL STOCKS	93	44	11	60	1
PERCENT OF TOTAL	44%	21%	5%	29%	0%

SPECIES OVERVIEW REPORTS

An overview report is presented for each species of salmon or steelhead within a river basin or regional area. These overviews provide discussions of the definition and origin of stocks and review any uncertainties relating to the decisions to list specific stocks. The overviews also present information on trends in escapement and run-size for the combined stocks of each species within a river basin or region. The individual Stock Reports follow each Overview Report.

STOCK REPORTS

Each stock of salmon and steelhead identified in SASSI is the subject of a report which presents detailed written descriptions of the rationales for the stock definitions in a **Stock Definition and Origin** section (which summarizes information on distribution, timing, and biological characteristics) and highlights any related uncertainties or caveats. Stock origin is also addressed with some discussion of the probable genetic make-up of each stock, and possible interactions with hatchery fish. The **Stock Status** section of these reports assesses the trends in escapement, production, or survival for each stock, and discusses the data used to measure current status. Stock ratings are also presented.

Additional written material was prepared for all stocks whose status was Depressed or Critical, and for some stocks in the Healthy and Unknown categories. The **Factors Affecting Production** section provides a brief description of harvest management, habitat status, and fish culture programs. The **Habitat** section reviews the general condition of the habitat used by each stock, and identifies specific environmental problems known to impact stock survivals. The **Harvest Management** section is a general discussion of the fisheries that impact each stock. The **Hatchery** section discusses salmon and steelhead culture programs in the areas utilized by each stock, and outlines possible interactions between wild fish and hatchery fish. **These discussions on factors affecting production are only meant to provide a very general overview of the type of problems faced by a stock.** More detailed examinations of these same topics will be developed for those stocks requiring priority attention as part of the overall Wild Stock Restoration Initiative (see SASSI Part 3 -- Current and Future Actions).

The material contained in Overviews, Stock Reports and Stock Profiles is sometimes a brief summary of far more extensive information available about stocks. Readers interested in obtaining more detailed information about specific stocks should contact the Washington Department of Fish and Wildlife or the Northwest Indian Fisheries Commission for referral to appropriate staff.

In some cases, the data available for use in SASSI are inadequate to determine whether naturally-spawning fish represent self-sustaining populations or whether they are maintained by frequent input from hatchery fish.

STOCK PROFILES

It is an objective of SASSI to provide a general presentation of the available information on each stock of salmon and steelhead included in the inventory. To accomplish this, a two page Stock Profile is included in each Stock Report to provide a quick review of the definition and status of each salmon and steelhead stock.

The first page is a **Stock Definition Profile**, which summarizes the three criteria used in defining individual stocks; including spawning distribution, timing, and biological characteristics.

Spawner distribution is shown on a generalized basin maps, and distinct distribution is noted if applicable. These maps are provided to demonstrate differences in distributions among stocks and are not intended to show exact spawning locations. In some cases, spawning distributions are unknown, and the basin maps are left blank. This does not mean that such a stock cannot be distinct based on spawner distribution. The belief that a self-sustaining population is thought to be present in a stream or streams can validate the stock, even if exact spawning locations are unknown. Distinct spawning distribution based on available survey data are the most commonly used criterion for identifying individual stocks in the SASSI process because general information on the geographic location of spawning and spawning habitat is the most readily available.

Timing of various life stages is presented in graphic form, and again any distinctions (differences among stocks) are identified. Distinct temporal distribution identifies stock differences based on variations in timing of critical life stages, e.g. spawning or return timing.

Biological characteristics are summarized at the bottom of the stock definition page. Distinct biological characteristics can include any observable distinctions among stocks such as size, age structure, scale patterns, parasites, or genetic differences. This criterion is applied in a number of different ways in this inventory. For some stocks, the stock differentiation is based on observable physical attributes.

However, genetic distinctions are the most common biological characteristic used in this document. There are indirect and direct approaches in SASSI for using genetic characterizations to distinguish among stocks. The indirect approach makes assumptions about the genetic makeup of a group of fish such as when it has been substantially changed by past or continuing introductions of non-native stocks. The direct approach is based on genetic stock identification (GSI), which is a method that can be used to characterize populations of organisms based on the genetic profiles of individuals. The GSI methodology relies on the combined use of biochemical, genetic, and statistical procedures to discriminate among populations. A more detailed discussion of the methods and applications of the use of GSI in SASSI is presented in the following Genetic Stock Identification section. Where GSI information exists it is graphically presented in the form of a dendrogram.

The second page is a **Stock Status Profile**, which presents current stock status information. The data used to determine stock status are presented in tabular and graphic form. Data quality is also noted. These data sets will vary by species and stock, depending on the nature of available stock specific information. The purpose of the numerical data are to describe the stock production trends, and may include data sets that are direct measures of abundance (e.g. escapement or run size), as well as less direct statistics like fish/mile and fish days. Both direct and indirect data can be used to express trends. For a discussion of the types of data used in SASSI to evaluate stock status, see the following Stock Assessment Data section.

The distribution (percentage) of harvest and escapement are shown in the form of a pie chart, where stock specific data are available.

The final section of the Stock Profiles presents a summarized description of stock status, including stock origin, type, and current status. The terms used in the Stock Summary section of the profiles are defined below.

Stock Origin - The terms dealing with the origin of stocks identify the genetic history of each stock.

> **Native** -- An indigenous stock of fish that has not been substantially impacted by genetic interactions with non-native stocks, or by other factors, and is still present in all or part of its original range. In limited cases, a native stock may also exist outside of its original habitat (e.g. captive brood stock programs).
>
> **Non-native** -- A stock that has become established outside of its original range.
> **Mixed** -- A stock whose individuals originated from commingled native and non-native parents, and/or by mating between native and non-native fish (hybridization); or a previously native stock that has undergone substantial genetic alteration.
>
> **Unknown** -- This description is applied to stocks where there is insufficient information to identify stock origin with confidence.

Production Type - The terms defining production type are describing the method of spawning and rearing that produced the fish that constitute each stock.

> **Wild** -- A stock that is sustained by natural spawning and rearing in the natural habitat, regardless of parentage (includes native).

Cultured -- A stock that depends upon spawning, incubation, hatching, or rearing in a hatchery or other artificial production facility.

Composite -- A stock sustained by both wild and artificial production.

Stock Status - These terms describe the current condition of each stock of fish and may be based on trends in escapement, run size, survival, or fitness levels.

Healthy Stock -- A stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock.

Depressed Stock -- A stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.

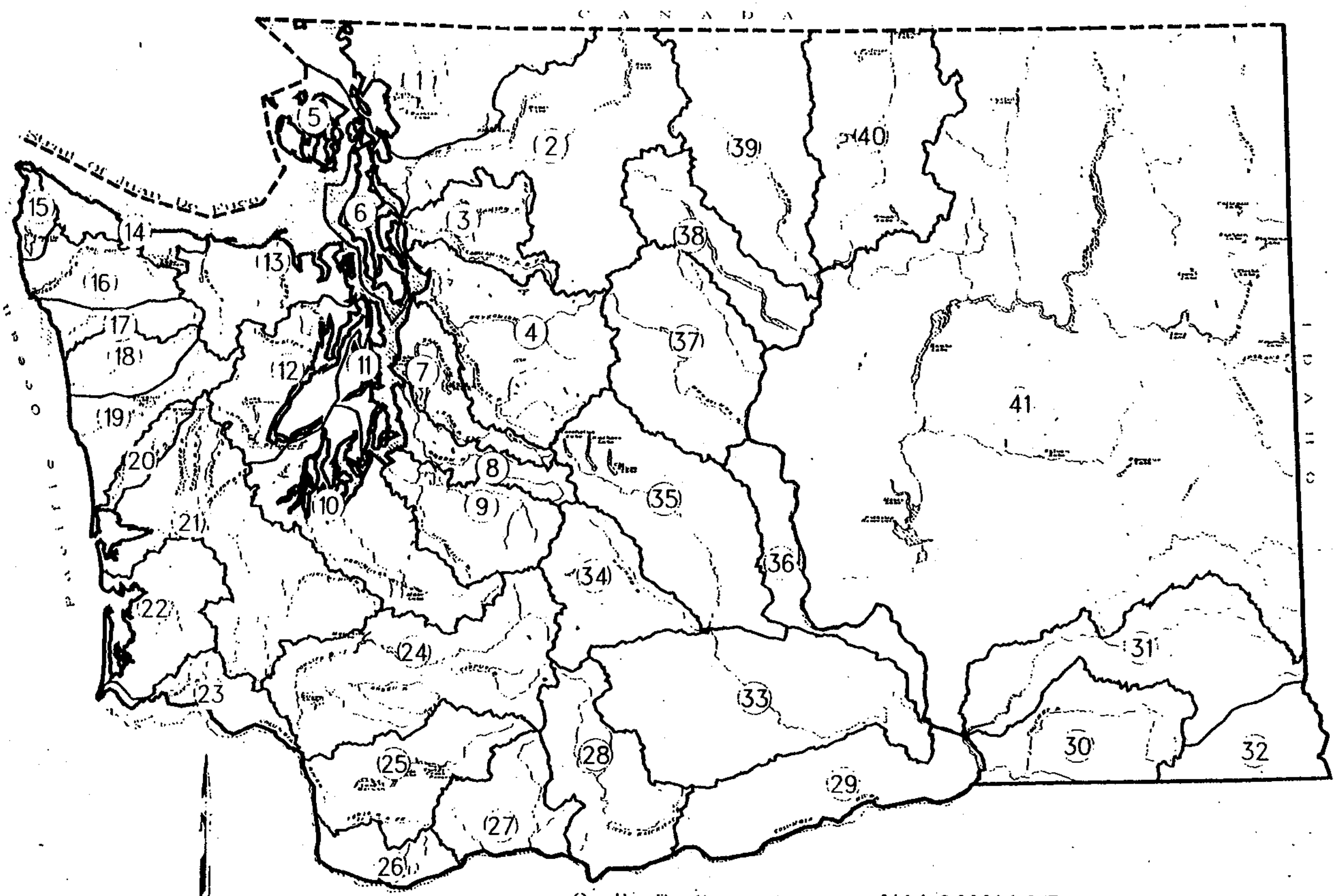
Critical Stock -- A stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred.

Extinct Stock -- A stock of fish that is no longer present in its original range, or as a distinct stock elsewhere. Individuals of the same species may be observed in very low numbers, consistent with straying from other stocks.

Unknown Stock -- This description is applied to stocks where there is insufficient information to identify stock status with confidence.

SASSI SALMON AND STEELHEAD RIVER BASINS

SASSI Stock Definition Profiles display spawning distribution information for the salmon and steelhead stocks in Washington State on river basin maps. These maps are scaled not only to present spawner distributions, but must also fit the format of the profile pages. This sometimes makes it difficult to relate a specific river basin map with adjacent systems. To help orient the reader, the state map on the following page locates the river basins used in SASSI. These SASSI river basins are not the same as Water Resource Inventory Areas (WRIA), which are used by Washington State natural resource agencies (Williams et al. 1975).



WASHINGTON STATE
Salmon and Steelhead River Basins

This appendix volume covers the North Puget Sound region.

PUGET SOUND

North Puget Sound
- 1- Nooksack/Samish
- 2- Skagit
- 3- Stillaguamish
- 4- Snohomish
- 5- San Juan Islands
- 6- Whidbey Island

South Puget Sound
- 7- Lake Washington
- 8- Duwamish/Green
- 9- Puyallup
- 10- Nisqually/Deep South Sound
- 11- East Kitsap

Hood Canal/ Strait of Juan de Fuca
- 12- Hood Canal
- 13- Elwha/ Dungeness
- 14- West Strait

COASTAL WASHINGTON

North Coast
- 15- Sooes/Ozette
- 16- Quillayute
- 17- Hoh
- 18- Queets
- 19- Quinault

Grays Harbor
- 20- Humptulips
- 21- Chehalis

Willapa Bay
- 22- Willapa/Nemah/Naselle

COLUMBIA RIVER

Lower Columbia River
- 23- Grays/Elochoman
- 24- Cowlitz
- 25- Kalama/Lewis
- 26- Washougal

Upper Columbia River
- 27- Wind/White Salmon
- 28- Klickitat
- 29- Rock Creek
- 30- Walla Walla/Touchet
- 31- Snake/Tucannon
- 32- Asotin/Grande Ronde
- 33- Lower Yakima
- 34- Naches
- 35- Upper Yakima
- 36- Hanford Reach
- 37- Wenatchee/Entiat
- 38- Lake Chelan
- 39- Methow
- 40- Okanogan
- 41- No anadromous fish

GENETIC STOCK IDENTIFICATION

In SASSI, distinct biological characteristics can include any observable distinctions between stocks such as size or age structure, but are most commonly identified for chinook, chum, pink, and sockeye salmon by screening for genetic differences using a technique called **Genetic Stock Identification**. GSI is a method that can be used to characterize populations of organisms based on the genetic profiles of individuals. The methodology relies on the combined use of biochemical, genetic, and statistical procedures to characterize and discriminate stocks.

Although the GSI characterization of stocks and testing of stock structure provides a direct measure of genetic interrelationships, it is important to be aware of limitations of this approach. It is presently possible to investigate only a tiny and restricted fraction of the genetic traits of salmon by the electrophoretic analysis of proteins. To the extent that the characters that can be investigated do not represent the entire genome, the view of genetic interrelationships derived from GSI analysis will be incomplete (and could fail to detect existing reproductive isolation among stocks -- see below). Indeed, there are a large number of genetically influenced characteristics of salmon about which there is little or no information. It is assumed that most or all of the genetic variation that can be studied by electrophoresis is not subjected to natural selection, that is, it is selectively neutral. While this assumption seems justified given much of population genetics theory and a considerable amount of empirical data from a number of organisms, exceptions to it could complicate or even invalidate some of our interpretations. It must also be realized that the statistical test (e.g. G-test) of stock structure, can be reasonably used to establish the existence of multiple stocks but not to disprove that multiple stocks exist. While statistically significant differences among samples provide strong evidence for the existence of distinct gene pools (i.e. separate stocks), the absence of significant differences does **not** constitute proof that only a single stock exists.

As currently applied to the investigation of stocks of Pacific salmon, the GSI process consists of a series of steps: (1) Collect selected tissues (usually muscle, heart, eye, and liver) from a representative sample of individuals (usually 100 or more) from the population(s) under investigation, (2) Develop genetic profiles (at 15 or more variable loci) for the individuals in each population by conducting starch-gel electrophoresis and biochemical staining using tissue extracts, (3) Characterize each population sampled by aggregating the individual genetic profiles and computing allele frequency distributions, and (4) Conduct statistical tests (G-tests or chi-square) using the allele counts characterizing each population.

Electrophoresis is a process whereby charged molecules (such as enzymes and other proteins) are separated in an electric field. It is possible to document the genetic characteristics of individuals (and populations) using starch-gel electrophoresis, because of the relationship between the genetic code (DNA) and enzyme biochemical phenotypes. These phenotypes are expressed, after electrophoresis and enzyme staining, in the form of banding patterns on the gels. Each enzyme (protein) subunit is encoded by a specific segment of DNA - a gene locus - which specifies its structure. When a locus exhibits genetic variation it has two or more alternate forms or alleles. Much, but not all, of the allelic variation of enzyme-coding loci can be detected by electrophoretic analysis because it results in structural changes to the enzymes.

Reproductively isolated populations usually develop significant differences in allele frequencies at one or more loci over time. The power of GSI to identify and characterize stocks is derived from the differential distribution of alleles at many gene loci in different stocks.

The hypothesis being tested in step 4 (see above) - that the allele distributions of the populations being compared are no more different than multiple independent samples from a single, freely interbreeding population - is closely tied to the definition of stocks as reproductively isolated populations. A statistically significant result in this test causes the rejection of the null hypothesis and typically leads to the conclusion that the populations tested are genetically different and, therefore, represent distinct stocks (breeding units). The commonly used 0.05 rejection level is applied as a cutoff value to indicate statistical significance in these tests. The power of the statistical tests is dependent on the numbers of fish in the samples being compared. Because of this, differences in allele counts that are not significant at small sample sizes can become significant if the sample sizes are large enough.

Typically, the genetic testing of stock structure begins with G-tests (or chi-square tests) involving pairs of individual collections. When such tests reveal significant differences, this is usually considered to be evidence for the existence of two genetically distinct stocks. However, in some cases individual collections are combined during the testing process. This is usually done when there are two or more separate collections from the same locality (usually taken in different years). The individual collections are combined in such cases because it is believed that the combination provides a better characterization of the population than does any single sample. Samples may also be combined from adjacent localities after testing of the separate collections has revealed no significant differentiation among them. For example, if six separate samples of Skagit River pink salmon are collected from different localities (and possibly in different years) and no evidence of significant genetic differences among them is found, they may be combined to characterize pink salmon in the entire river system and this aggregate subsequently tested against collections or similar aggregates from nearby drainages (e.g. Nooksack River, Stillaguamish River, etc.).

In addition to the direct testing of stock structure using the G-test approach, dendrograms based on average genetic distances among samples have been used to summarize the genetic interrelationships among stocks. This commonly used approach provides a simple one-dimensional graphical representation of overall stock similarities and differences. The lengths of the horizontal branches that connect stocks in dendrograms are proportional to the average genetic distances between the stocks. The vertical position of individual stocks in a dendrogram does not necessarily reflect genetic relationships because each branch point is actually a point around which the lower level branches can be rotated without distorting the estimated genetic distances between them and other stocks in the dendrogram.

While dendrograms are useful because they simplify the often complex patterns of genetic interrelationships among stocks, they are not without disadvantages. The absolute magnitude of differences identified by this technique is influenced both by the specific suite of gene loci included in the analysis and the particular genetic distance measure used. As individual stocks that are most similar are connected in the process of building the dendrogram, their relationships to other stocks can be distorted. The dendrogram analysis **is not** a test of stock structure, in part because it is independent of sample size. Thus, while dendrograms can be useful for depicting genetic interrelationships among stocks and for summarizing among-stock diversity, they cannot be used to define or identify distinct stocks genetically; this must be done using the results of the direct statistical tests (e.g. G-test).

STOCK ASSESSMENT DATA

The evaluation of the current status of the stocks of salmon and steelhead identified in SASSI is based on the best available escapement, harvest, run size, and survival data. Only stock specific data were used, which sometimes limited the available data to a short span of recent years. These data were plotted and qualitatively examined for changes in abundance or survival. Often, only a single stock specific statistic was available to analyze the production trend of a stock. When multiple types of data could be used to examine individual stock status, the available production or survival data sets were examined individually and each stock's rating was based on the statistic(s) that best described the current status.

The Stock Reports and Stock Status Profiles present the stock assessment data for individual stocks. The following discussion defines those stock assessment terms used in the evaluation of wild Puget Sound salmon and steelhead stocks.

ESCAPEMENT DATA

For salmon and steelhead stocks, the term escapement refers to those mature fish that have returned to freshwater, have survived (escaped) all fisheries, and constitute the spawning population for a given stock. Escapement data collected during spawning ground surveys and by counts made at traps and fish passage facilities are the most frequently used sources of information on the status of salmon and steelhead stocks. Some types of escapement data represent a direct measure of all of the fish making up a spawning population. Examples of direct escapement measurements would include total escapement estimates, and trap and dam counts. For many stocks, direct escapements are not available and indirect escapement numbers are used to evaluate stock status. Indirect escapements are generally actual count data for specific spawning ground reaches (index areas) and are usually collected on an annual basis. Examples would be redd or fish/mile counts. Indirect counts do not provide total escapements, but rather are relative data sets that can be used to indicate changes in abundance and long-term escapement trends.

The following escapement data sets were used to determine the status of various wild Puget Sound salmon and steelhead stocks.

ESCAPEMENT

Carcass	The highest daily count of dead fish (carcasses) in an index area.
Dam count	A total count of fish destined for spawning grounds upstream of a dam.

Fish-days	The total number of fish days (one fish present for one day) in an index area over an entire spawning season.
Fish/mile	A spawner count divided by the number of miles surveyed.
Hat & Nat	Total number of hatchery and natural fish escaping to a particular stream area.
Index total	An estimate of total escapement in an index area.
Peak count	The highest daily count of live fish in an index area.
Peak redds	The highest daily count of redds (spawning nests) in a stream index area.
Rack count	A total count of fish destined for spawning grounds upstream of a rack.
Redds	A count of redds (spawning nests) in a stream index area.
Redds/mile	A redd count divided by the number of miles surveyed.
Snorkel Index	A count of adults observed while snorkeling an index area.
Total	An estimate of all fish of a stock that have survived all fisheries and make up a spawning population.
Trap count	A total count of fish destined for spawning grounds upstream of a fish trapping facility.

HARVEST DATA

The numbers of fish harvested in various major fisheries can be used to measure relative abundance and to observe long-term trends. Harvest data sets are typically for specific fisheries or regions and do not necessarily represent all of the catches made everywhere that impact the stock. For example, total harvest might refer only to the combined sport and commercial harvest in the Puget Sound system, but may not include ocean catches.

The following types of harvest data were used to assess the current status of some Puget Sound salmon and steelhead stocks.

<u>HARVEST</u>

Total — The combined catches of all fisheries in a specific region. In some cases, catch data for some fisheries may be unavailable, but the available catch data are thought to be representative of total harvest trends.

Net — The total net catches in a major fishery or the combined tribal and/or commercial net catches in a specific region.

Sport — The total catches in a single sport fishery or the combined catches in all sport fisheries in a specific region.

RUN SIZE DATA

The term run size refers to the total number of salmon and steelhead measured at a particular point in their return migration, e.g. the total numbers entering Puget Sound. Run size estimates may not include all returning fish (e.g. a small harvest component may not be included), but the run sizes presented in SASSI are believed to be complete enough to represent the relative abundance of the stock. Run size data are not available for many stocks because of the difficulty in identifying stock specific harvests in mixed stock fisheries.

The following run size data were used to determine the status of some Puget Sound stocks.

<u>RUN SIZE</u>

Inside — The total numbers of fish leaving the ocean on their return migration. For Puget Sound stocks, the inside run includes all fish entering the Strait of Juan de Fuca (Washington waters only).

Total — The combined escapement and harvest of a stock of fish in a specific region, but may not include all of the catches made everywhere for a specific stock.

Trap count — A total count of fish destined for areas upstream of a fish trapping facility.

JUVENILE DATA

Counts of juvenile salmon and steelhead at various life stages are used to measure relative abundance and evaluate trends. These count data are most commonly collected during the freshwater incubation, rearing, or migration periods, and may include any life stage from egg to smolt. Juvenile count data are also used to measure a variety of survival rates.

JUVENILE

PS/100m2	The average number of presmolts (juveniles enumerated immediately before the smolt stage) produced per 100 square meters of habitat.
No./100m2	The average number of juveniles (of various age classes) produced per 100 square meters of habitat.
Smolts	The number of smolts produced by spawners from a broodyear.

SURVIVAL DATA

The survival of fish of a given broodyear can be expressed as a ratio between any two life stages, and when collected over a number of years can provide a measure of the success of specific stocks. Recruits per spawner is the most commonly used survival statistic for salmon and steelhead stocks because it expresses the total survival for a given parent year spawning.

SURVIVAL

PS/spawn	The number of presmolts (juveniles enumerated immediately before the smolt stage) divided by the number of total spawners from a broodyear.
Rec/spawn	The number of returning adults (recruits) divided by the number of spawners from a broodyear.
Smolt/egg	The survival rate from egg to smolt expressed as a percentage.
Smolt/Fem	The number of smolts divided by the number of female spawners from a broodyear.

NO DATA

For many stocks of salmon and steelhead, there are no stock specific data that can be used as measures of stock status. These stocks are typically small populations and are rated as Unknown status stocks.

NORTH PUGET SOUND STOCK REPORTS

OVERVIEW -- SUMAS/CHILLIWACK FALL CHUM STOCK

SUMAS/CHILLIWACK

STOCK DEFINITION AND ORIGIN

Chum salmon are known to spawn in Saar Creek, a tributary to the Sumas River. The Sumas flows north into British Columbia and enters the Fraser River via the Vedder-Chilliwack system. Occasionally, chum have also been seen in other Sumas tributaries including Breckenridge and North Fork Johnson creeks. These chum are separated geographically from all other Puget Sound stocks. Live adult chum salmon have been observed in Saar Creek from late October to early January with the peak usually in November.

It is assumed that Sumas chum are a component of the Vedder-Chilliwack stock. This stock enters the Fraser River from October through December and spawns throughout the Vedder-Chilliwack drainage, with the majority of spawning activity occurring in Canadian waters. There is a hatchery component, and mixing between hatchery and wild fish occurs frequently.

Although no genetic testing has been done on chum from the Sumas, chum from the Chilliwack have been examined and shown to be different from all Washington and other Fraser chum stocks.

STOCK STATUS

The exact relationship of the Sumas component of the Chilliwack chum run is unknown, as is the size of the Sumas component. Chum salmon escapements into the Vedder-Chilliwack have ranged from 40,000 to 320,000 over the last ten years. It is presumed that these chum contribute to various commercial and tribal fisheries in both U.S. and Canadian waters. They may also be incidentally taken in sport fisheries.

More information on this stock is presented in the following Stock Report.

TRANSBOUNDARY INDEPENDENTS -- SUMAS/CHILLIWACK FALL CHUM

STOCK DEFINITION AND ORIGIN

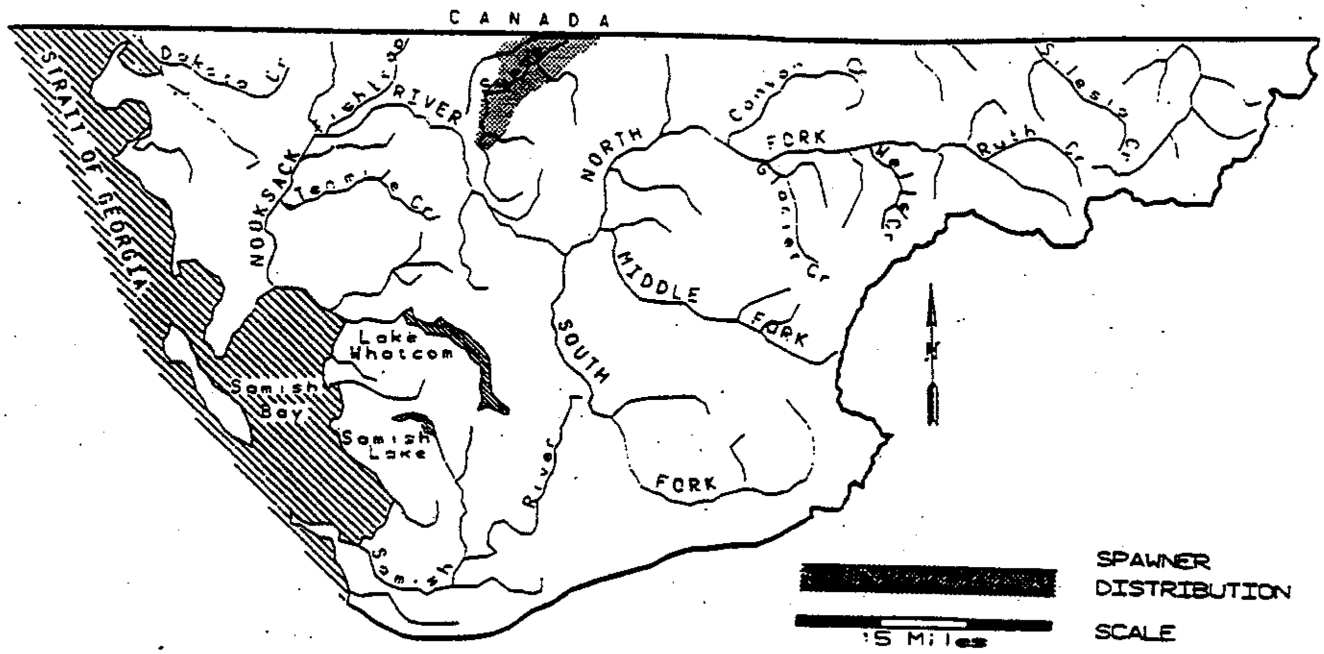
Chum in the Sumas and Chilliwack rivers are separated geographically from other chum stocks. In Washington waters, the stock is wild and presumed to be native. Most spawning occurs during November and December. Chum are regularly found in small numbers in Saar Creek, a Sumas tributary. They are occasionally seen in other Sumas tributaries.

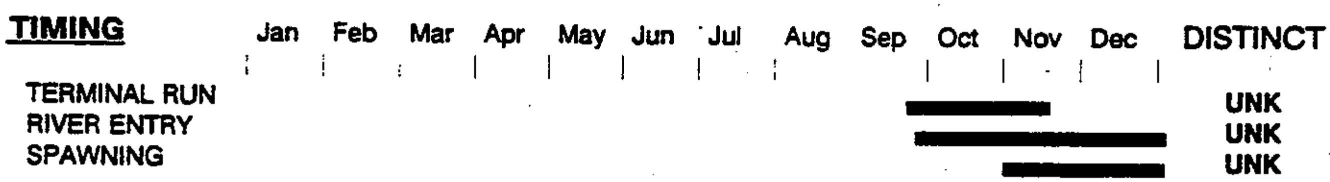
STOCK STATUS

The status of the stock is Unknown. Total numbers of chum salmon spawning in the Sumas are unknown. Since 1984, peak counts in a 1.2 mile spawning ground index area have ranged from four to 55 chum adults (live and dead combined). This area includes most of the suitable chum spawning area in Saar Creek. Based on annual escapements that often exceed 100,000, the Chilliwack chum stock is apparently Healthy. However, as the exact relationship of Sumas chum to chum in the rest of the drainage has not been resolved, the status of the Sumas component must be considered to be Unknown.

STOCK DEFINITION PROFILE for Sumas/Chilliwack Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**





BIOLOGICAL CHARACTERISTICS
DISTINCT? - **PROBABLY**

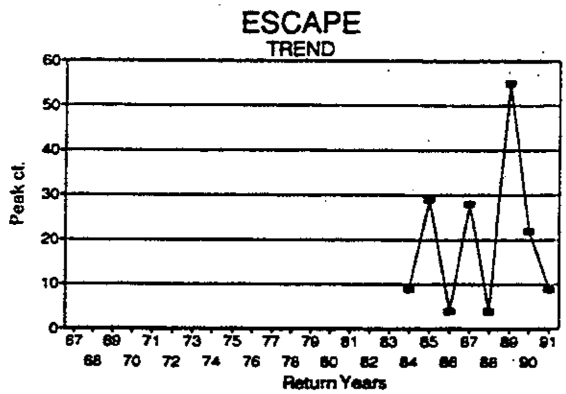
GENETICS - The Sumas River is a transboundary river that flows into the Fraser River via the Chilliwack River system. Fish from the Chilliwack River and other major Fraser River tributaries were GSI sampled from 1986-1988. All Fraser River chum stocks are genetically distinct from all Washington stocks (21-locus G-tests: $p<0.05$).

STOCK STATUS PROFILE for Sumas/Chilliwack Fall Chum

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Peak ct.			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84	9			
85	29			
86	4			
87	28			
88	4			
89	55			
90	22			
91	9			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Genetic

STOCK STATUS
Unknown

SCREENING CRITERIA

OVERVIEW -- SUMAS/CHILLIWACK COHO STOCK

SUMAS/CHILLIWACK

STOCK DEFINITION AND ORIGIN

Coho salmon are known to spawn in tributaries to the Sumas River. The Sumas flows north into British Columbia and enters the Fraser River via the Vedder-Chilliwack system. The Sumas tributaries most heavily used for spawning include Saar, Breckenridge, and North Fork Johnson creeks. These coho are separated geographically from all other Puget Sound stocks. Live adult coho salmon have been observed in Sumas tributaries from late October to early January with the peak usually from late November to early December.

It is assumed that Sumas coho are a component of the Vedder-Chilliwack stock. Coho appear at the mouth of the Fraser about the third week of August. The Chilliwack stock enters the Fraser River from September through November and spawns throughout the Vedder-Chilliwack-Sumas drainage. There is a large number of hatchery coho which pass through Chilliwack Lake. No quantitative information is available for this component of the run.

STOCK STATUS

Total numbers of coho salmon in the Sumas are unknown. According to Canadian biologists, total Chilliwack coho escapements generally range from 50,000 to 100,000, including the hatchery component. These coho would contribute to various commercial and tribal net and troll fisheries in U.S. and Canadian waters. They would also be taken in sport fisheries in both coastal and inside waters.

More information on this stock is presented in the following Stock Report.

TRANSBOUNDARY INDEPENDENTS -- SUMAS/CHILLIWACK COHO

STOCK DEFINITION AND ORIGIN

Coho in the Sumas and Chilliwack rivers are separated geographically from other coho stocks. The relationship of the coho spawning in Washington waters to those in the rest of the drainage is unknown. Spawning occurs primarily during November and December. Coho in the Sumas are wild and assumed to be native although some Nooksack coho have been planted into the system as unfed fry. Coho ascending through Chilliwack Lake may be of mixed wild and hatchery origin. No genetic testing has been done on coho from the Sumas.

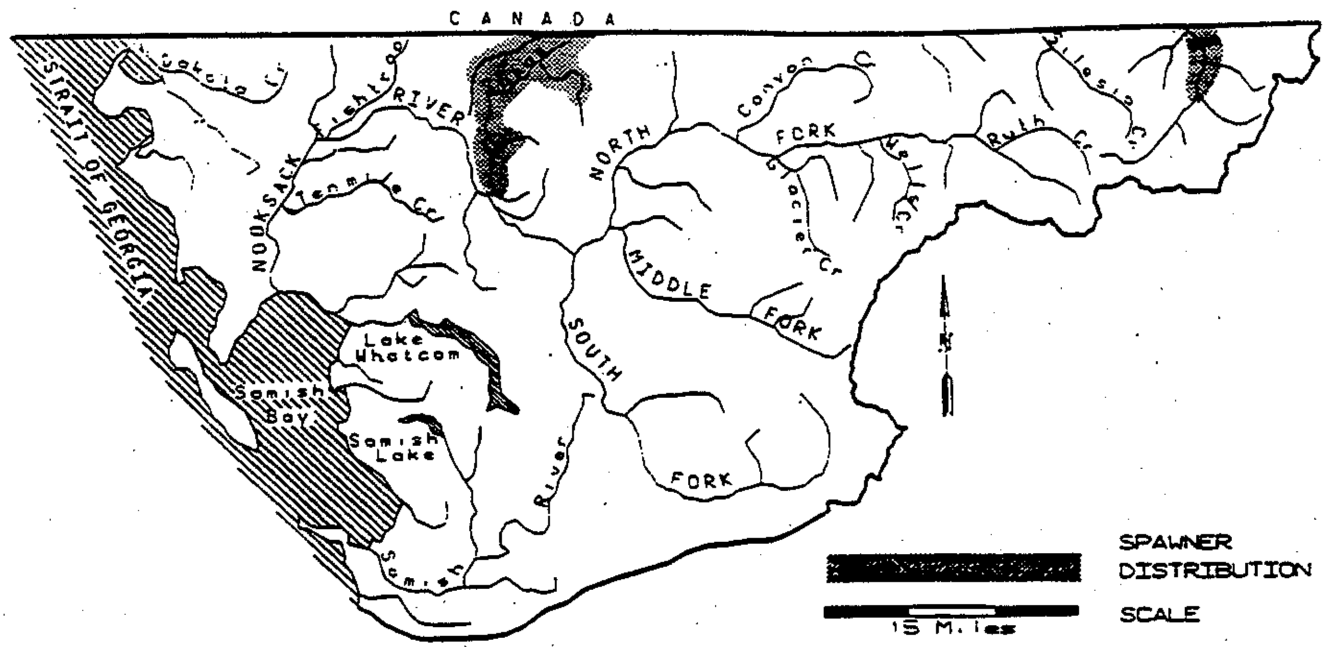
STOCK STATUS

Though the total number of coho spawning in Washington waters is unknown, spawning ground surveys indicate that the escapement into the Sumas probably exceeds 1,000 fish in most years. No information is available on the number of coho entering Washington waters via Chilliwack Lake. The Chilliwack run is apparently healthy, and the status of the component that spawns in Washington waters is Unknown.

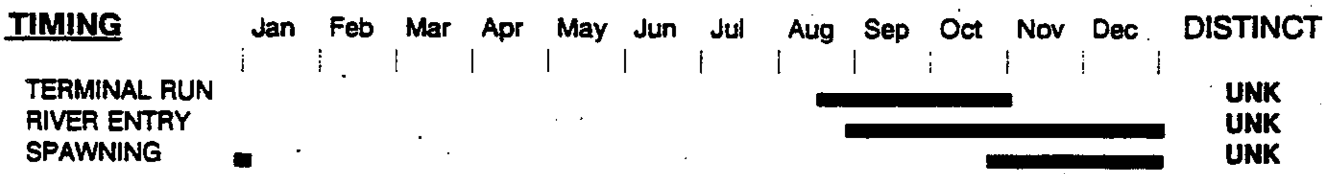
STOCK DEFINITION PROFILE for Sumas/Chilliwack Coho

SPAWNER DISTRIBUTION

DISTINCT? - **YES**



TIMING



BIOLOGICAL CHARACTERISTICS

DISTINCT? - **NO**

STOCK STATUS PROFILE for Sumas/Chilliwack Coho

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	NO DATA			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

OVERVIEW -- NOOKSACK/SAMISH CHINOOK STOCKS

NORTH FORK NOOKSACK
SOUTH FORK NOOKSACK
SAMISH/MAINSTEM NOOKSACK FALL

STOCK DEFINITION AND ORIGIN

The historical record of the salmon resources and fisheries in the Nooksack and Samish watersheds is incomplete. Earlier-migrating chinook were the first fish available to the indigenous inhabitants and had important cultural and subsistence significance. There appear to have been fish readily available from April through the beginning of the sockeye runs in July. A later-timed stock of chinook was introduced at the Nooksack Hatchery. This stock was of Green River origin and is currently produced from Nooksack Hatchery, Samish Hatchery and the Lummi Sea Ponds.

Based upon genetic composition analysis, spawn timing and spawning distribution, there are three distinct chinook stocks in the Nooksack basin. Two stocks are of native origin and are referred to as North Fork Nooksack and South Fork Nooksack chinook based upon spawning distribution differences. The third stock has been introduced from Green River, and has a spawning distribution that partially overlaps with the North Fork Nooksack chinook stock. The spawn timing of the introduced Green River stock is a typical summer/fall chinook spawn timing that begins in mid-September and continues through October. This stock is referred to as the Samish/ Mainstem Nooksack fall stock, as transfers between the Nooksack and Samish hatcheries readily occur. All three stocks are genetically different from each other. Genetic baselines have been developed for Nooksack native chinook. The North Fork baseline is based on collections made in 1986 and 1988 and combines samples from hatchery and wild fish. The South Fork baseline used samples from wild fish collected in 1985. A Nooksack/Samish fall chinook baseline was constructed using hatchery samples collected in 1986. All three baselines are significantly different from one another, however, the Samish/Mainstem Nooksack fall chinook baseline is closely related to the baselines of other fall chinook stocks which have been widely distributed such as Green River.

Low levels of straying occur between North Fork and South Fork native chinook stocks. From 1984-1990, nine chinook released from the South Fork hatchery program returned as adults to the hatchery on the North Fork. During the same time period, one North Fork-origin chinook was recovered from South Fork spawning grounds.

Because of partial spawn timing overlaps and recent incomplete tagging at the Nooksack Hatchery, North Fork native chinook and Samish/Mainstem Nooksack fall chinook were interbred at the Nooksack Hatchery in 1991. The progeny were removed from the Nooksack basin, and an otolith marking program was initiated to mark all North Fork native chinook to maintain stock separation at the hatchery. No evidence of interbreeding prior to 1991 has been found.

STOCK STATUS

Sporadic spawner surveys in the North Fork Nooksack began in the 1940s, with standard procedures implemented in 1981. Most North Fork spawning occurs above river mile (RM) 45.0 and in larger tributaries.

In the South Fork, foot surveys in an index area between RM 24 and 27.5 were initiated in 1952. Since 1979, snorkel surveys from RM 20.7 to RM 8.7 provided more information on the spawning areas in the South Fork. With the recognition of a problem in production from earlier migrating chinook (North Fork and South Fork stocks), a cooperative program was initiated in 1980 to gather more accurate information on stock identification and life history of the native stocks.

A radio-tagging study on fish entering the river before July suggested a four-stage migration pattern: (1) entry, (2) migration, (3) holding, and (4) spawning. The spawning spanned from August 7 to September 22 in the North Fork, and was about two weeks later for the South Fork stock. A juvenile tagging program indicated peak emergence of fry in March and April with some emergence evident until June. An analysis of wild spawner scale samples indicated that about 91% were sub-yearling migrants. About 11%, 71% and 17% return as three-, four-, and five-year-olds, respectively.

Observations in the South Fork suggest that these chinook require holding pools with cover prior to spawning and that they are selective in their spawning areas.

Enhancement of an early migrating stock of chinook began at Nooksack Hatchery in 1975. Sol Duc and Hood Canal stocks were used until 1981. At this time, the Sol Duc and Hood Canal stocks were removed from the Nooksack River. Beginning in 1980, the native brood stock program was started with chinook collected from the North Fork Nooksack River for use in the rebuilding program. Since the early 1980s, the North Fork Nooksack chinook program has grown significantly within the Nooksack Hatchery, but increases in wild spawner levels have not yet followed.

The enhancement program for the South Fork Nooksack chinook stock began in 1980 with wild brood stock collections adjacent to the Skookum Hatchery. Production levels rose to over 100,000 smolts released in 1985 and 1986 but then dropped to below 10,000 for subsequent years.

There is no question that the North Fork and South Fork Nooksack chinook stocks are in a critical condition. The egg bank program can sustain the stocks for the short-term, but the habitat requirements must be fully understood and steps taken to recreate the habitat to which the fish were adapted before we can expect the resource to support even minimal fisheries.

The original habitat has changed significantly with settlers immigrating to the area. The heavily forested lowlands were cleared for farming in the late 1800s. This would have changed the flow regime in the lowlands, creating greater run-off and higher temperatures in the river. In the past, shipping traffic occurred as far upstream as Lynden. The river was used to transport logs to booming grounds in the Bellingham Bay delta. The lower river was changed significantly by the diversion of flow from the Lummi or Red River channel to the Bellingham Bay channel. The upper Nooksack watershed has been more heavily harvested since the 1950s and this has led to increased sediments, changes in channel structure and variations in water flow and temperature.

The chinook were not a prime commercial fish in the early years due to the limitations in processing technology. The sockeye and pink salmon were the most prized fish for canning. The tribes in the Nooksack basin were the primary harvesters of chinook in the region.

Most harvest of Nooksack native chinook stocks occurs in Canadian fisheries, with some harvest in Puget Sound net and sport fisheries.

More information on each stock is presented in separate Stock Reports.

NOOKSACK/SAMISH -- NORTH FORK NOOKSACK CHINOOK

STOCK DEFINITION AND ORIGIN

This stock is distinguished from other chinook in the basin by differences in genetic composition, run and spawn timing and geographical distribution. Genetic analyses are based on collections made in 1986 and 1988 which combined samples from wild and hatchery fish. No genetic data are available for fish presently spawning in the wild, however, collections from wild and hatchery fish are now being made. Run timing is usually from July through early September. Spawning typically starts in early August and continues into late September. This stock tends to spawn earlier than the South Fork Nooksack stock, although there is overlap in spawn timing between the two stocks. Geographical locations of spawning grounds are distinct from those of the South Fork stock, as most spawning occurs in the mainstem North Fork from RM 44.8 - 63.9 and to a very limited extent in the associated tributaries such as lower Middle Fork Nooksack, Maple, Canyon, Cornell, Boyd and McDonald creeks. Spawning escapement data collection has been greatly hampered by poor visibility due to the glacial origin of the North Fork.

Major habitat degradation in the principal tributaries previously used for spawning led to initiation of a data gathering and stock recovery program which has continued since 1981. A part of the recovery program involved egg banking at the Nooksack Hatchery on Kendall Creek, a North Fork tributary. Agreed tribal/state production goals (Puget Sound Salmon Management Plan 1985 and U.S. v. Washington, 1974) now call for release of 200,000 North Fork fingerlings annually. As a result, a preponderance of spawning now takes place in the hatchery or close to it. This hatchery program may affect the validity of carcass counts elsewhere in the system as indicators of wild spawning abundance. To encourage distribution of the stock in areas of the North Fork historically used by chinook, additional fingerlings are acclimated in a pond built for this purpose on Deadhorse Creek. The effectiveness of this program in redistributing spawning to non-hatchery habitats is being evaluated.

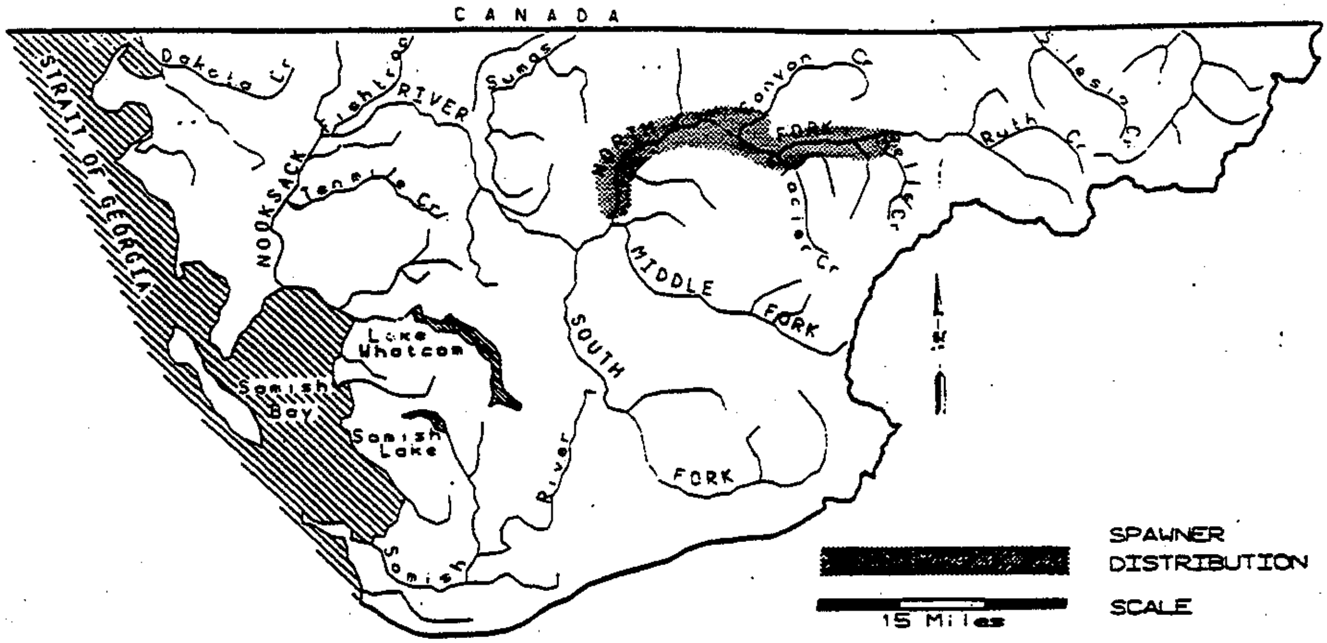
Historically there have been introductions of Green River and other non-local chinook to the Nooksack Hatchery. Enhancement of the North Fork native stock through supplementation from the hatchery used Sol Duc and Hood Canal chinook stocks from 1975 through 1981. Brood stock was collected from the river in 1981 and 1982. Some mixing of naturally spawning native fish and hatchery strays of non-local origin may have occurred while collecting "native" brood stock in the river since the Sol Duc stock was unmarked.

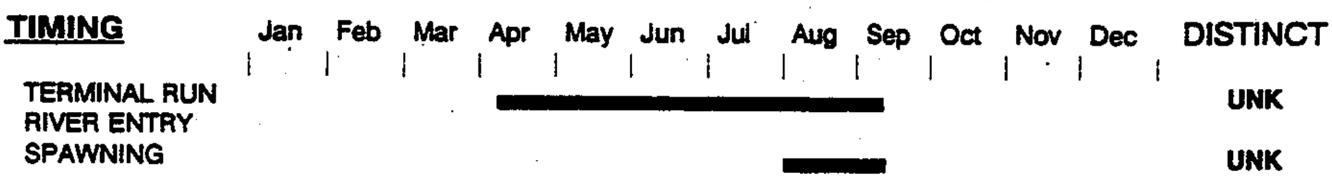
STOCK STATUS

A Critical status has been assigned to this stock based on an annual average of 17 carcass recoveries during the period from 1989-1991 and an average annual recovery of 62 carcasses from 1985-1988. The relation between carcass recovery

STOCK DEFINITION PROFILE for North Fork Nooksack Chinook

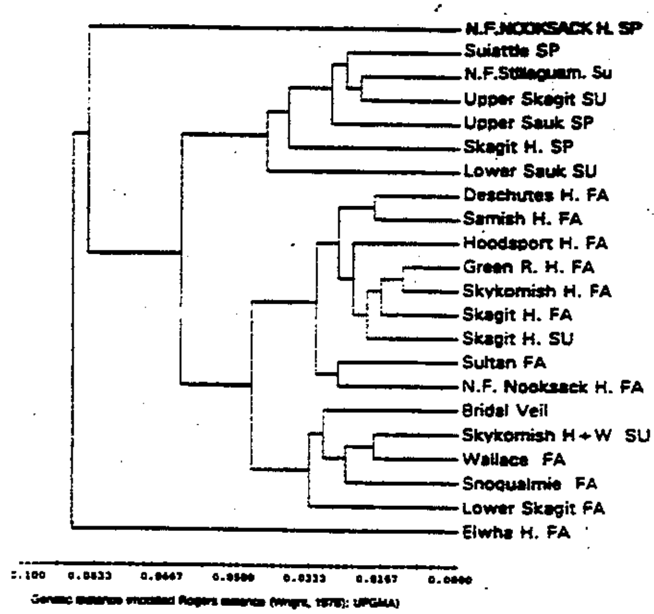
SPAWNER DISTRIBUTION
DISTINCT? - **YES**





BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Genetic data from samples of wild fish used for hatchery broodstock in 1985 and 1988 show this stock to have unique genetic chatracteristics and to be significantly different (**p**< 0.05) from all other Puget Sound chinook stocks examined. No genetic data for wild spawners exist at this time.

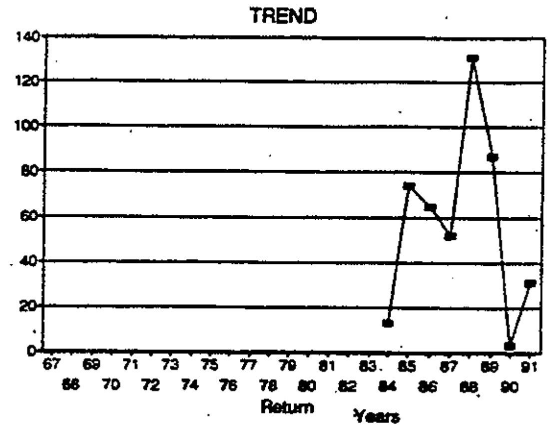


STOCK STATUS PROFILE for North Fork Nooksack Chinook

STOCK ASSESSMENT

DATA QUALITY-----> Poor

Return Years				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84	13			
85	74			
86	65			
87	52			
88	131			
89	87			
90	3			
91	31			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Composite

STOCK DISTINCTION
Distribution, Genetic, Timimg

STOCK STATUS
Critical

SCREENING CRITERIA
Chronically Low

and actual escapement is not clear. Although carcass recoveries of natural spawners are declining, overall spawning abundance based on hatchery returns and releases seems to be on the increase.

FACTORS AFFECTING PRODUCTION

Habitat -- In 1982-83, as part of the initial recovery effort for North Fork chinook, 14 tributaries in the North Fork and lower Middle Fork were studied because of their importance as spawning areas for salmon (Schuett-Hames and Schuett-Hames 1984). These tributaries included Porter, Bell, Kenney, Coal, Racehorse, Maple, Boulder, Canyon, Hedrick, Cornell, Gallup, Thompson, Boyd and Deadhorse creeks. It was concluded that stream instability was widespread and appeared to be the most important factor affecting stream productivity in the Nooksack. More than three-fourths of the streams were ranked unstable. Moderate to high levels of fine sediments combined with instability indicated that there was a high likelihood of low juvenile survival to emergence from gravel in most of the streams surveyed. Debris torrents which directly destroy both habitat and developing eggs were also identified as a major problem.

These major problems all relate to past and present land-use patterns. Extensive and intensive logging, and associated road building in the watershed, which has continued unabated since the early 1970s has resulted in massive slope failures and has denuded much of the North Fork Nooksack basin. In addition, a high percentage of watersheds within the basin lack sufficient canopy cover which has led to increases in peak stream flows and scouring and to decreases in slope stability.

A diversion dam on the Middle Fork at RM 7.2, coupled with natural barriers, prevents access to important upstream habitat which is important to North Fork chinook.

There is a lack of habitat diversity in the lower river for returning spawners. Specifically there is insufficient large organic debris in the stream which provides hiding cover and creates pools, and diking and agricultural practices have degraded stream habitat quality. Sedimentation has adversely affected estuarine habitat at the mouth of the Nooksack River in Bellingham Bay.

Another major problem in the lower Nooksack River is that the confluence with the Lummi River, which flows out of the Nooksack River at RM 4.5 has been blocked off so outmigrating smolts have no access to estuarine rearing habitat in Lummi Bay.

Because of these habitat problems, the success of restoration efforts based on the hatchery supplementation program coupled with outplants of fingerlings into acclimation areas historically used by chinook in the North Fork system (Deadhorse

Creek and Canyon Creek areas) is uncertain. Habitat restoration efforts to correct past and ongoing habitat losses in the North Fork are essential in order for recovery programs to be effective.

Harvest Management --

Preterminal Fisheries - Harvest impacts have been examined using coded-wire tag recoveries of North Fork native chinook released from the Nooksack Hatchery (broodyears 1981 -1987). Canadian interceptions account for about 47% of the total recoveries, while Puget Sound net and sport catches account for about 14% and 7% of total recoveries, respectively (Smith, 1993).

Terminal Fisheries - There is currently no directed net harvest on North Fork Nooksack chinook. Area closures and size limits have been imposed on local sport fisheries. Incidental harvest of native chinook in other fisheries are difficult to determine with confidence. Harvest rates for North Fork chinook are not available (run reconstruction does not distinguish North Fork chinook from South Fork or from fall chinook).

To better assess effects of fishing mortality on escapement, there is a need to improve evaluation of the impacts of Canadian fisheries and to improve data collection methods and catch reporting for non-directed preterminal sport and terminal ceremonial fisheries.

Hatchery -- The Nooksack Hatchery on Kendall Creek has operated since 1899. The current goal of the North Fork native chinook program at the hatchery is to help restore a naturally spawning population capable of sustaining some level of harvest. The eggtake goal for this program has not been determined, however some recent annual eggtakes from fish returning to the hatchery have been in excess of one million eggs. For the 1981 and 1982 broods, brood stock was taken from the North Fork. Subsequently the hatchery has used only adults returning to the hatchery for supplementation. A program is underway to outplant hatchery-reared fingerlings into areas of the North Fork basin with suitable acclimation sites. The acclimation pond on Deadhorse Creek has acclimated 100,000 fish per year in recent years. The effectiveness of unacclimated off-station releases of fingerlings will also be tested.

Native chinook brood stock returning to the Nooksack Hatchery have been separated from returning Samish/Mainstem Nooksack fall chinook based on time of entry into the hatchery. Prior to 1992 chinook entering the hatchery by September 1 and spawning by September 9 were identified as North Fork Nooksack native chinook. Chinook entering the hatchery and spawning after these dates were identified as Samish/Mainstem Nooksack fall chinook. In 1992, a more conservative process to better separate North Fork native chinook from the Samish/Mainstem Nooksack fall chinook stock was initiated because hybridization occurred between the North Fork native chinook and the fall hatchery stock using the September 1 separation date.

The hatchery entry dates and spawning dates which are used to identify native chinook were changed to August 25 and September 1 respectively. In addition to using coded-wire tags to distinguish the two stocks (in high eggtake years, not all native chinook can be tagged), all native chinook are otolith-marked to distinguish them from fall chinook.

Last ten years salmon releases into the Nooksack basin.

Release Year	Spring Chinook	Fall Chinook	Chum	Coho
1982	0	14576579	877660	8339325
1983	130530	14603809	1558068	4785671
1984	24727	12875503	1972960	5746554
1985	209071	10373058	407000	8888736
1986	315835	6382537	1470832	8536671
1987	267600	12453174	1417100	4403619
1988	94591	7777611	582475	5905826
1989	1468184	5191900	2002700	5771161
1990	1124918	9073463	2144100	4250096
1991	355069	6085398	3747900	2881940
MEAN	443392	9939303	1618080	5950960

NOOKSACK/SAMISH -- SOUTH FORK NOOKSACK CHINOOK

STOCK DEFINITION AND ORIGIN

This stock is defined as a distinct stock based on geographical distribution of spawning, run and spawn timing and genetic composition. Data on geographical spawning distribution, based on redd counts, are much better for this stock than for North Fork Nooksack chinook in part because visibility in the South Fork is better than in the North Fork. Most spawning in the South Fork Nooksack occurs between RM 23.9 to 30.4. Run and spawn timing for South Fork chinook peak two to three weeks after those for North Fork chinook. As for the North Fork, the amount of genetic information is limited, and current data on naturally spawning fish are not available.

The origin of South Fork chinook is thought to be native. Because this stock is located further from the Nooksack Hatchery on Kendall Creek, a North Fork Nooksack tributary, than the North Fork stock, there may be less opportunity for interbreeding between the hatchery fall chinook stock and this stock than between the hatchery stock and the North Fork stock. Low levels of straying between the North and South forks have been documented, however there is no evidence of significant hybridization between this stock and the North Fork or Samish/Mainstem Nooksack fall stock. Egg banking and a supplementation program for this stock have been underway at the Skookum Creek Hatchery (Skookum Creek is a South Fork tributary) since 1980.

STOCK STATUS

South Fork Nooksack chinook have been assigned Critical status based on chronically low escapements. The escapement estimates are based on redd counts and are considered to be good estimates of relative abundance from year to year. The estimated escapement has averaged 340 adults from 1984-1992 and, although large annual variations occur, does not show an upward or downward trend.

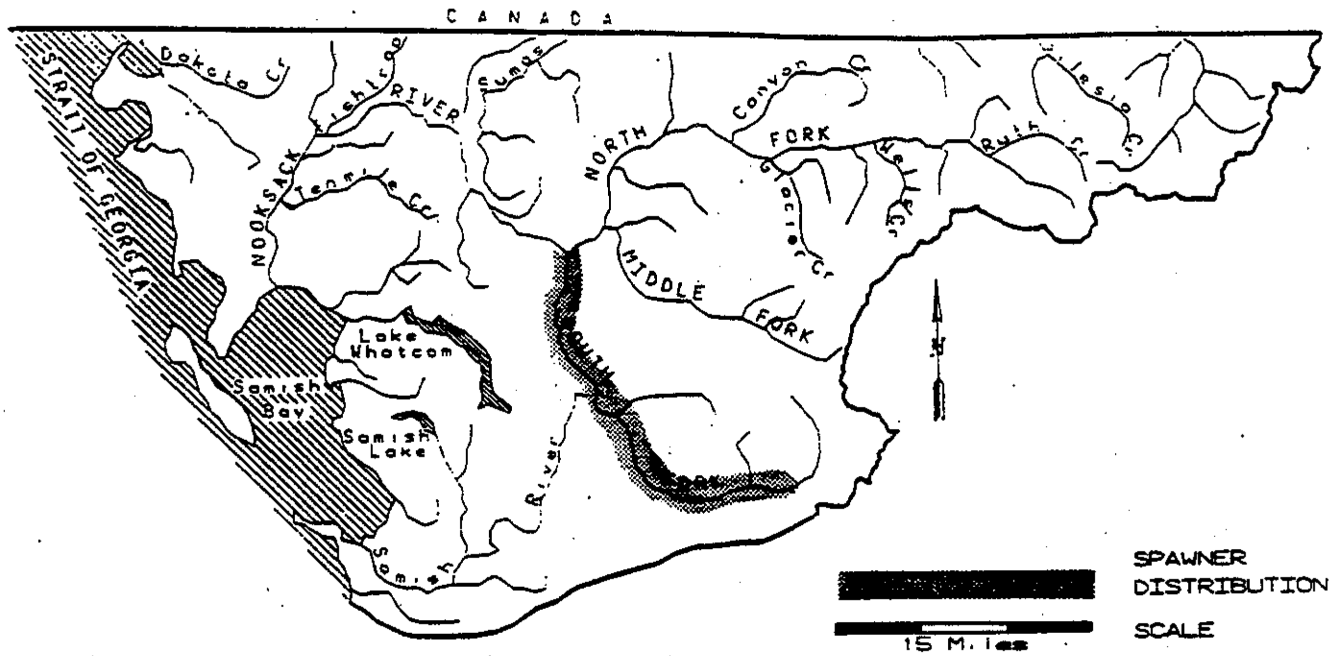
Hatchery production has failed to augment the natural spawning population. Because of decreasing availability of hatchery and natural brood stock, there is a concern about the potential effect of the hatchery program on the genetic integrity of the stock. The future of the hatchery program is being evaluated.

FACTORS AFFECTING PRODUCTION

Habitat -- A joint study by the Lummi Nation, Nooksack Tribe and the U.S. Fish and Wildlife Service (Schuett-Hames et al. 1988) examined the quality and availability of adult holding and spawning habitat for South Fork chinook. The authors concluded that the amount of holding and spawning habitat was not limiting for the small

STOCK DEFINITION PROFILE for South Fork Nooksack Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY													**UNK**
SPAWNING													**UNK**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **PROBABLY**

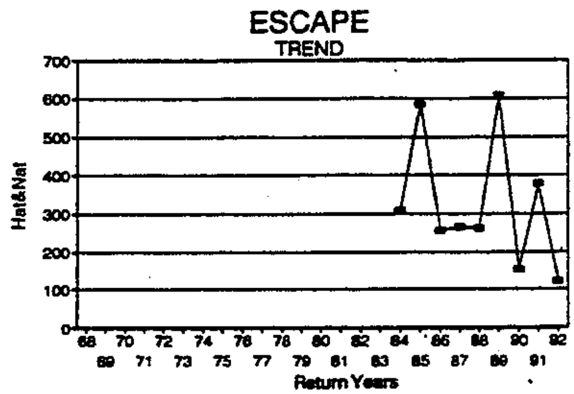
GENETICS - Incomplete genetic data exist for S.F. Nooksack Hatchery chinook from a 1985 sample. In older comparisons with other Puget Sound stocks, this hatchery collection was significantly different. A new sample should be taken to verify these differences. No dendrogram is available.

STOCK STATUS PROFILE for South Fork Nooksack Chinook

STOCK ASSESSMENT

DATA QUALITY-----> Very Good

Return Years	ESCAPE Hat&Nat		ESCAPE Redds	
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84	309		188	
85	585		445	
86	257		170	
87	266		248	
88	263		233	
89	608		606	
90	152		142	
91	379		365	
92	122		103	



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Timing, Genetic

STOCK STATUS
Critical

SCREENING CRITERIA
Chronically Low

numbers of chinook observed at the time (1986), but that both holding and spawning habitat were of poor quality and would likely be limiting for recovering populations. Habitat quality problems were attributed to logging and associated road-building on steep hill slopes adjacent to the river. Impacts to habitat used for holding included decreased pool depth, increased water temperature and lack of large woody debris to create habitat diversity. There are numerous instances of landslides along clay banks in the mainstem South Fork, often adjacent to clearcut areas, and many tributaries show evidence of landslides. Spawning habitat has been degraded by increased fine sediments in spawning gravels.

Like the North Fork Nooksack, the South Fork shows extensive stream braiding and channel instability. These problems are concentrated in RM 19.0 to RM 30.4 which includes the area of greatest chinook spawning activity (RM 23.9 - 30.4). Lack of riparian canopy cover in the South Fork has a greater impact than in the North Fork because the South Fork is not glacially fed, so water temperatures are inherently higher than in the North Fork. Lack of riparian canopy has produced water temperatures at or above lethal levels for salmonids during the season when adult chinook return to the river.

The South Fork chinook stock faces the same downstream problems as the North Fork stock, i.e. a lack of habitat diversity for upstream migrants, blockage of the Lummi River which prevents juveniles from rearing in Lummi Bay and sedimentation of the nearshore estuary in Bellingham Bay.

Harvest Management --

Preterminal Fisheries - Harvest impacts have been examined using coded-wire tag recoveries of South Fork native chinook released from the Skookum Hatchery (broodyears 1981-1987). Canadian interceptions account for about 64% of the total recoveries, while Puget Sound net and sport catches account for about 11% and 8% of total recoveries, respectively (Smith 1993).

Terminal Fisheries - There is currently no directed commercial net harvest on South Fork Nooksack chinook. Area closures and size limits have been imposed on local sport fisheries. Incidental harvest impacts on this stock are difficult to determine with confidence. Harvest rates for South Fork chinook are not available (run reconstruction does not distinguish South Fork chinook from North Fork chinook or from fall chinook).

To better assess effects of fishing mortality on escapement, there is a need to improve evaluation of the impacts of Canadian fisheries and to improve data collection methods and catch reporting for non-directed preterminal sport and terminal ceremonial fisheries.

Hatchery -- Production intent for the Skookum Creek Hatchery is to supplement the native stock through on-station releases with possible off-station releases in the future. A goal is to tag all juveniles released from the hatchery. The eggtake goal is 100,000 eggs annually. Although eggtakes exceeding the goal were obtained in two years since 1980, in recent years low brood stock availability has kept eggtakes below 20,000. At present, the future of the hatchery program is under evaluation.

The release history of the hatchery program has been:

Year	Number Released
1980	73,000
1981	54,000
1982	22,270
1983	13,695
1984	60,000
1985	57,000
1986	114,000
1987	141,000
1988	12,550
1989	31,400
1990	15,000
1991	10,000

NOOKSACK/SAMISH -- SAMISH/MAINSTEM NOOKSACK FALL CHINOOK

STOCK DEFINITION AND ORIGIN

This stock is distinct from other chinook stocks in the Nooksack basin based upon spawn timing and genetic composition analysis.

Spawning begins in mid-September and peaks in October. This differs from the earlier spawn timing seen in the two native Nooksack chinook stocks, but is similar to other Puget Sound summer/fall chinook stocks. There is a two week potential overlap in spawn timing between the Nooksack native chinook stocks and the Samish/Mainstem Nooksack fall chinook stock. The stock component in the Samish River is geographically distinct, but geographical overlap with the North Fork Nooksack spring chinook occurs in the Nooksack River.

This stock is a non-native, introduced stock originating from fall chinook in the Green River. Its genetic composition and spawn timing is distinct from the North and South Fork native chinook stocks in the Nooksack basin. However, the Samish/Mainstem Nooksack fall chinook are genetically closely related to Green River summer/fall chinook and all other summer/fall chinook stocks which have significant influence from Green River transfers. The genetic baseline was developed from collections in 1986 from the Nooksack and Samish hatcheries. No collections of naturally-spawning chinook have been made. Egg transfers routinely occur between Samish and Nooksack hatcheries, justifying the designation of the Samish and Mainstem Nooksack fall chinook as a single stock. Influence from other stocks are highly possible considering the extent of the recent stock transfers into this program. The following table illustrates the transfer of stocks other than Nooksack or Samish fall chinook into the hatchery program since 1973.

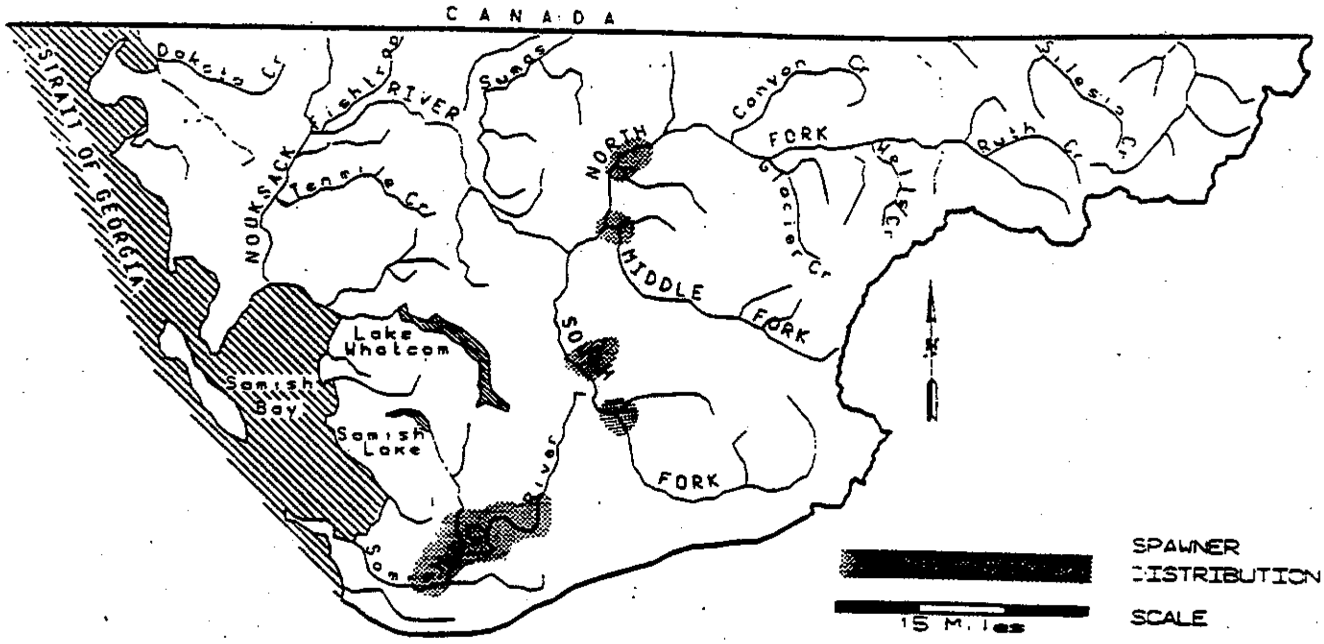
STOCK STATUS

The status of the stock is Unknown. There is insufficient information to rate the status of the stock is either Healthy, Depressed, or Critical.

STOCK DEFINITION PROFILE for Samish/MS Nooksack Fall Chinook

SPAWNER DISTRIBUTION

DISTINCT? - **YES**



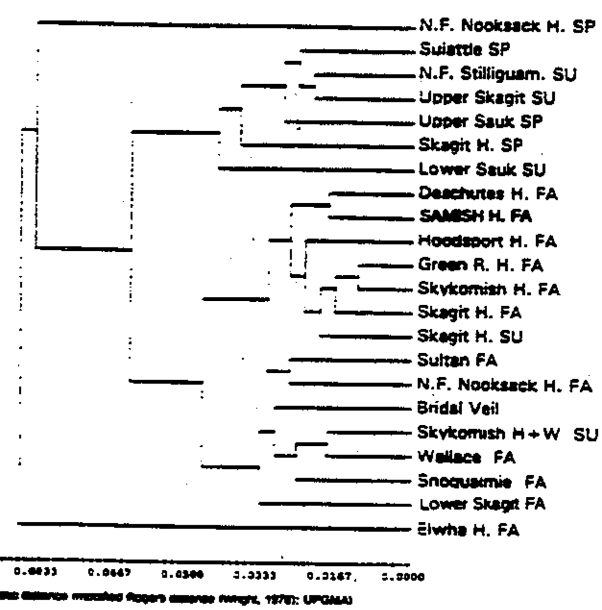
TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													UNK
RIVER ENTRY													UNK
SPAWNING													UNK

BIOLOGICAL CHARACTERISTICS

DISTINCT? - **POSSIBLY**

GENETICS - Samples of Samish Hatchery fall chinook from 1982 and 1986 show them to be significantly different in genetic characteristics than other Puget Sound stocks. However, because of transfers of fall chinook among Puget Sound hatcheries (such as the Samish, N.F. Nooksack, Skagit and Green River.) this distinctiveness may no longer exist. No genetic data for natural spawners exist at this time.



STOCK STATUS PROFILE for Samish/MS Nooksack Fall Chinook

STOCK ASSESSMENT

DATA QUALITY------> Poor

Return Years	NO DATA			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Non-native

PRODUCTION TYPE
Composite

STOCK DISTINCTION
Distribution, Timing, Genetics

STOCK STATUS
Unknown

SCREENING CRITERIA

Hatchery transfers to the Nooksack/Samish chinook program.

Broodyear	Number Released	Hatchery Stock
1973	454,912	Green River/Skagit
1974	728,606	Green River
1975	1,209,828	Skagit
1975	1,018,160	Green River
1976	519,138	Skagit
1976	1,208,899	Hood Canal
1976	370,049	Green River/Skagit
1976	295,133	Green River
1977	6,320,966	Green River
1977	120,849	Hood Canal
1978	3,334,313	Green River
1978	448,875	Hood Canal
1978	399,000	Univ. of Washington
1979	1,818,004	Green River
1980	4,678,600	Green River
1981	7,351,686	Green River
1987	637,500	Glenwood Springs

OVERVIEW -- NOOKSACK/SAMISH FALL CHUM STOCKS

NORTH FORK NOOKSACK
MAINSTEM/SOUTH FORK NOOKSACK
SAMISH/INDEPENDENT

STOCK DEFINITION AND ORIGIN

Wild components of chum salmon in the Nooksack River spawn from mid-November through mid-January. Peak spawning is in late December. Wild components in the Samish River, other tributaries to Samish and Bellingham Bays and Drayton Harbor peak in spawning from late November through early December. Because of the overlap in timing between all of the stocks, this criterion is only marginally useful in distinguishing separate stocks for Nooksack versus the Samish/Independent tributary groups and is not at all useful for distinguishing any potential stocks within the Nooksack or between the Samish component and independent tributary components. There have been hatchery supplementation efforts using both the earlier and the later spawning components.

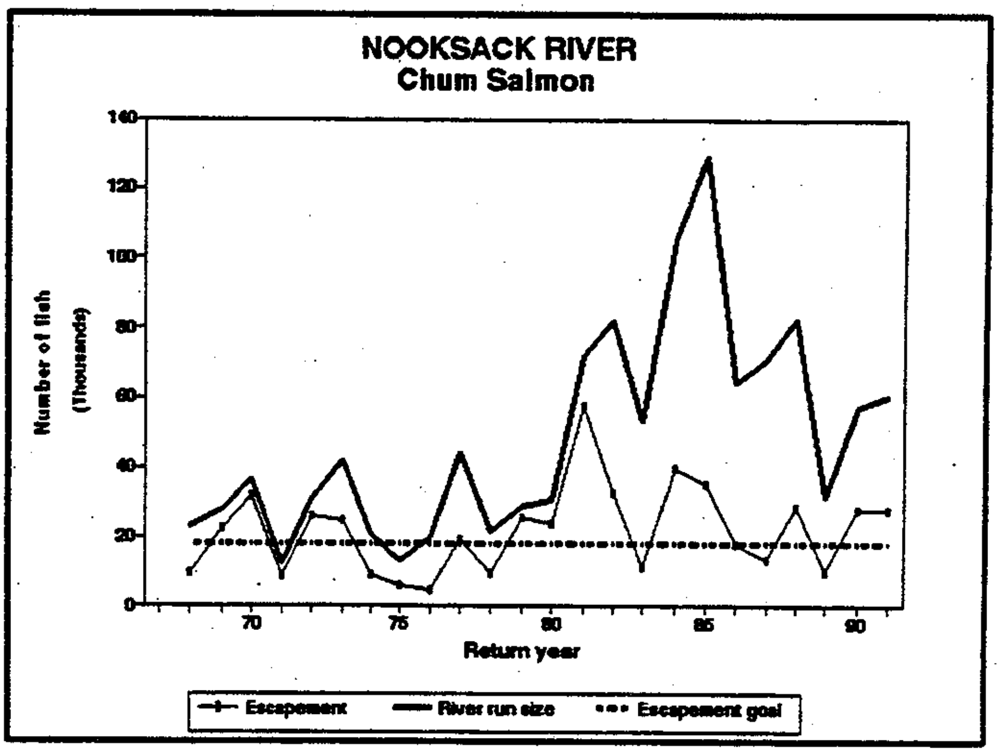
Natural spawning occurs in the North Fork, South Fork, lower part of Middle Fork, and the mainstem of the Nooksack and the lower parts of tributaries to all forks. Chum salmon also spawn in the Samish River, Oyster, Padden, Whatcom and Squalicum creeks tributary to Bellingham and Samish Bays and California and Dakota creeks which are tributaries to Drayton Harbor.

Three stocks have tentatively been identified in this region. Chum salmon spawning in the Nooksack River are distinguishable from those spawning in the Samish River and in independent tributaries by differences in genetic profiles and spawn timing as well as by geography. Stock distinctions within the Nooksack basin were based solely on geographical differences in spawning distribution. There is high certainty about a distinction between the Samish/Independent stock and the Nooksack stock. The Samish/Independent stock may include remnants of more than one stock considering the fairly wide range of geographic distribution of spawning.

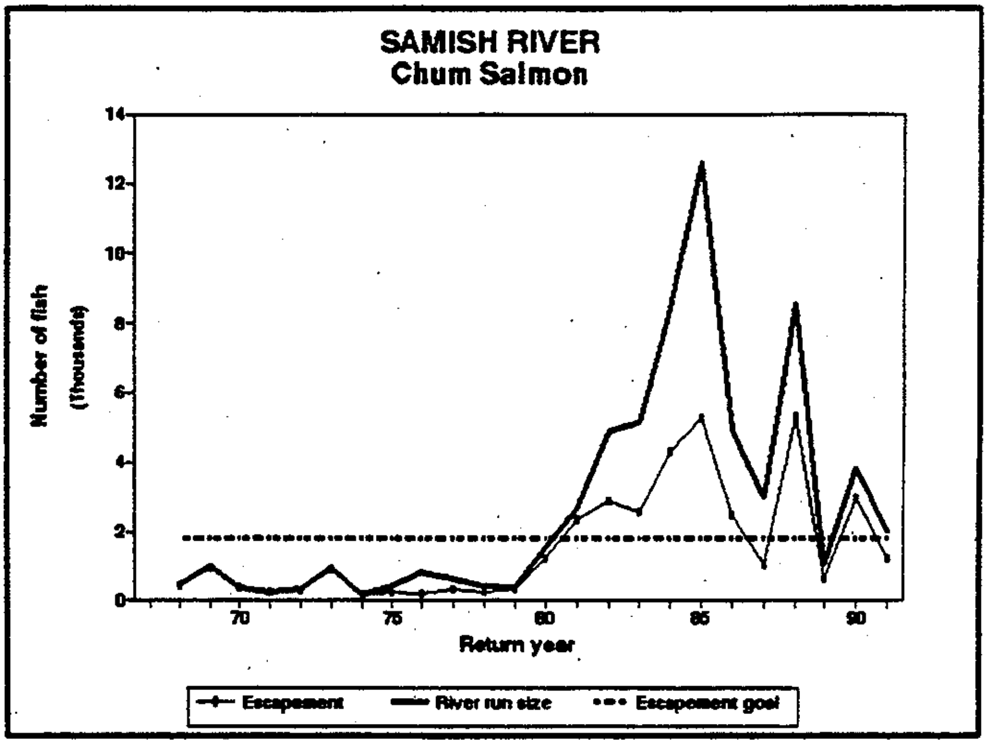
Nooksack chum are thought to be of native origin, however, chum of Grays Harbor- and Hood Canal-origin have been introduced into the system through supplementation projects of the Nooksack Hatchery and Lummi Bay Hatchery. The origin of the stock may also have been influenced by supplementation programs utilizing the Samish/Independent chum stock at the Maritime Heritage enhancement facility and the Lummi Bay hatchery. Electrophoretic studies of the North Fork Nooksack stock show it to be distinct from all other chum stocks which have been examined. The stock we have identified as Samish/Independent drainage chum is composed of one or more hybrid stocks, including Hood Canal-origin chum and possibly some native Samish chum influence.

STOCK STATUS

Estimated total annual returns of wild Nooksack chum from 1983 to 1992 have ranged from 31,000 to 130,000 (see figure). Hatchery releases and off-station releases also contribute to Nooksack chum returns, but the numbers are smaller. Estimated escapements of wild spawners have ranged from 10,000 to 40,000. These figures are for the entire drainage. The contribution of chum from each of the forks and the mainstem tributaries is unknown. Estimated total returns are calculated from escapement estimates and harvest data and do not include Canadian interceptions. Escapement estimates are based on a comparison of spawning ground counts in designated index areas to counts for the same index areas made in years when escapements were estimated by tagging studies. All spawning ground index areas are located in the North Fork drainage. The accuracy of these estimates is unknown, but they are good for showing trends because of consistency in survey methods and personnel.



Because of enhancement efforts, hatchery and wild fish are constantly being mixed in the Samish River and independent streams entering Samish and Bellingham Bays. Since there is no clear separation between the hatchery and wild components, the total return figures for these areas include hatchery contributions. Estimated total returns of Samish origin chum from 1982 to 1992 have ranged from 189 to 18,914 with the numbers escaping to spawn in the wild ranging from 93 to 11,450 (see figure). Estimated total returns of chum originating from other Bellingham-Samish Bay streams (including the hatchery at Whatcom Creek) have ranged from 5,680 to 18,160 with natural escapements ranging from 623 to 5,340. Much of the natural escapement to independent streams is due to returns from remote site incubators operated by enhancement groups using eggs from Whatcom Creek. The combined escapements, total returns, and escapement goal are presented in the following figure.



More information on each stock is presented in separate Stock Reports.

NOOKSACK/SAMISH -- NORTH FORK NOOKSACK FALL CHUM

STOCK DEFINITION AND ORIGIN

The North Fork Nooksack chum are separated geographically from all other chum stocks. There may also be some differences in spawn timing. This stock spawns in the mainstem North Fork Nooksack from its confluence with the South Fork (RM 36.0) upstream at least as far as RM 62.0. The preferred spawning habitat is in sloughs and braided side channel areas, and spawning activity is heaviest between Welcome (RM 41.0) and Kendall (RM 46.0) rivers. Chum also enter stable, low-gradient tributaries such as Kendall and Maple creeks. Chum that spawn in the lower Middle Fork side channels are grouped with this stock pending further investigation. Chum salmon also spawn in South Fork side channels and mainstem tributaries. These fish are tentatively considered to be a separate stock and will be discussed in a separate stock report. The North Fork stock is apparently the largest component of the run.

Chum salmon can appear at the mouth of the Nooksack as early as August and as late as March, but most fish enter between mid-October and mid-December, peaking in mid-November. Spawning in the North Fork drainage may begin in early November and extend to mid-January with the peak usually in mid- to late December. This is somewhat later than in other large northern Puget Sound rivers.

North Fork Nooksack chum are thought to be of native origin. However, chum of Grays Harbor- and Hood Canal-origin were introduced into the system at Nooksack Hatchery. Genetic evidence shows North Fork Nooksack chum to be distinct from all other chum stocks that have been examined. Chum from the mainstem tributaries or the South Fork have not been characterized, so the genetic separation between the various components of the Nooksack chum population is unknown.

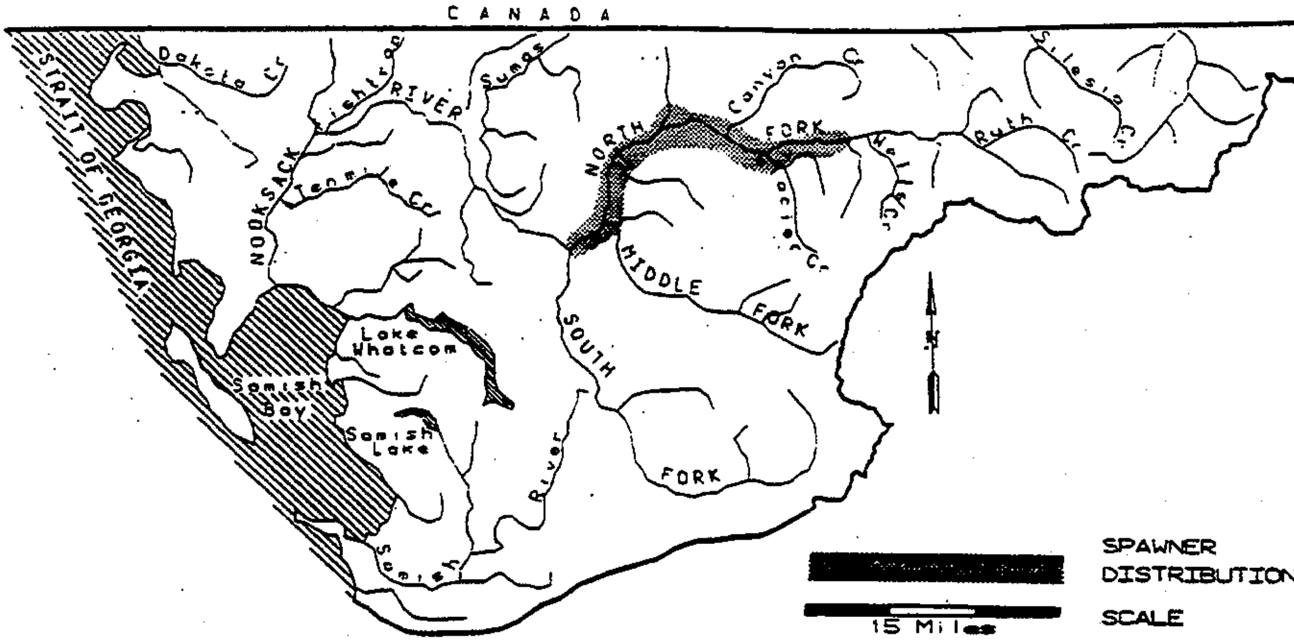
STOCK STATUS

The status of the stock is Healthy based on trends in spawner escapement.

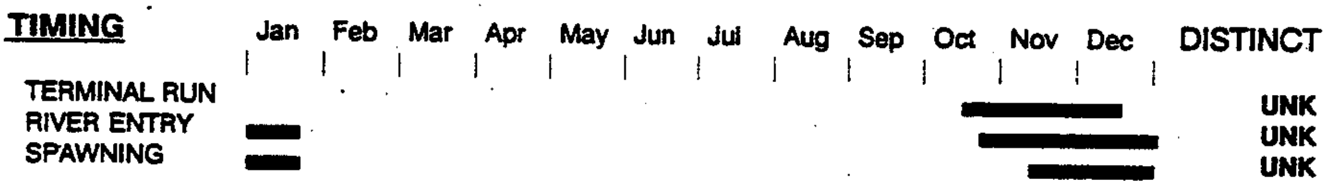
Estimated total annual returns of Nooksack chum over the last ten years have ranged from 35,000 to 130,000. The great majority of these are wild fish with hatchery and off-station plants contributing small numbers. Estimated escapements of natural spawners have ranged from 10,000 to 40,000. These figures are for the entire drainage. The contribution of chum from each of the forks and the mainstem tributaries is unknown. Estimated total returns are calculated from escapement estimates and harvest data and do not include Canadian interceptions. Escapement estimates are based on a comparison of spawning ground counts in designated index

STOCK DEFINITION PROFILE for North Fork Nooksack Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

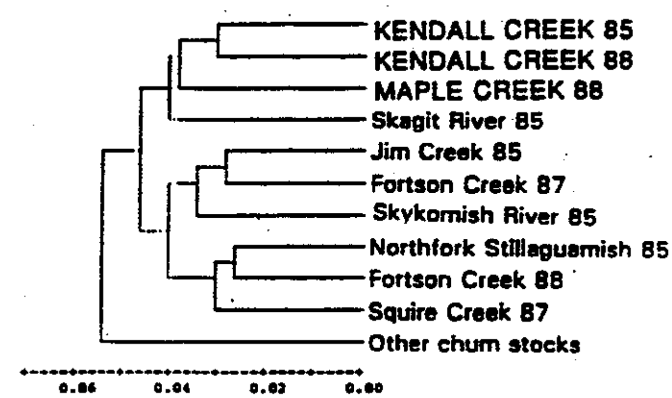


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Two GSI collections (N=100) have been taken from Kendall Creek in 1985 and 1988. Fish from Maple Creek were GSI sampled in 1988 (N=100). Maple Creek fish are significantly distinct from Kendall Creek fish (21-locus G-tests: **p**<0.05) and fish from both areas are significantly distinct from all other Washington and Canadian collections (21-locus G-tests: **p**<0.05).



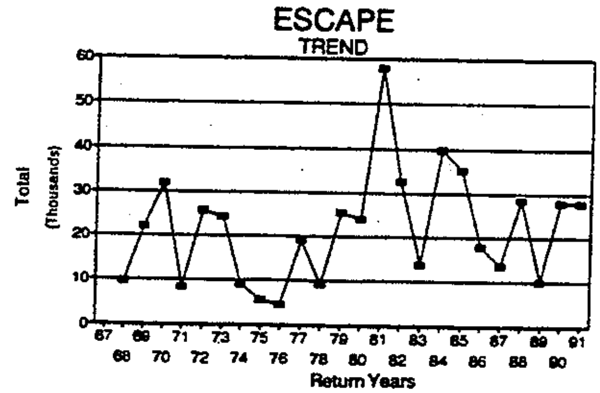
Genetic distance (modified Rogers distance (Wright,1978); UPGMA)

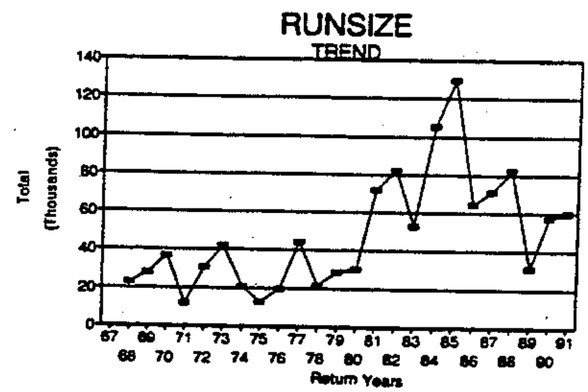
STOCK STATUS PROFILE for North Fork Nooksack Fall Chum

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total	RUNSIZE Total		
67				
68	9622	22819		
69	22182	28034		
70	31826	36930		
71	8380	11898		
72	25845	30926		
73	24420	41996		
74	9121	20748		
75	5609	12925		
76	4465	19710		
77	19064	44557		
78	9244	21399		
79	25547	28668		
80	23915	30134		
81	57822	71893		
82	32780	82378		
83	13675	53144		
84	39655	105290		
85	35261	129625		
86	17879	64439		
87	13589	71124		
88	28612	82586		
89	9992	31247		
90	27995	57305		
91	27888	60169		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Genetic

STOCK STATUS
Healthy

SCREENING CRITERIA

areas to counts for the same index areas made in years when escapements were estimated by tagging studies. All spawning ground index areas are located in the North Fork drainage. The accuracy of these estimates is unknown, but they are good for showing trends because of consistency in survey methods and personnel.

NOOKSACK/SAMISH -- MAINSTEM/SOUTH FORK NOOKSACK FALL CHUM

STOCK DEFINITION AND ORIGIN

Chum salmon spawning in the South Fork and Mainstem Nooksack tributaries are geographically separated from all other chum stocks. There may also be some differences in physical appearance, but this has not been confirmed. Chum are known to spawn in South Fork side channels between Acme and Saxon creeks (RM 9.0 to 12.0) and are occasionally seen in Hutchinson Creek, which enters this section. Chum are also found in larger Mainstem Nooksack tributaries including Fishtrap and Deer creeks.

Chum salmon can appear at the mouth of the Nooksack as early as August and as late as March, but most fish enter between mid-October and mid-December, peaking in mid-November. Spawning in the mainstem tributaries and South Fork drainage is known to occur in December, but surveys are spotty.

Mainstem tributary and South Fork chum are thought to be of native origin. However, chum of Grays Harbor- and Hood Canal-origin were introduced into the system at Nooksack Hatchery and into other nearby drainages. Genetic evidence indicates that Hood Canal-origin chum have hybridized with local native chum stocks in other areas such as the Samish River. No GSI characterization has been done on chum from the South Fork or Mainstem drainages so their relationships to other chum are unknown. The relationship between the components of this group (South Fork vs. Mainstem) is also unknown. Nooksack chum require further study before any definite statements regarding distinct stocks can be made.

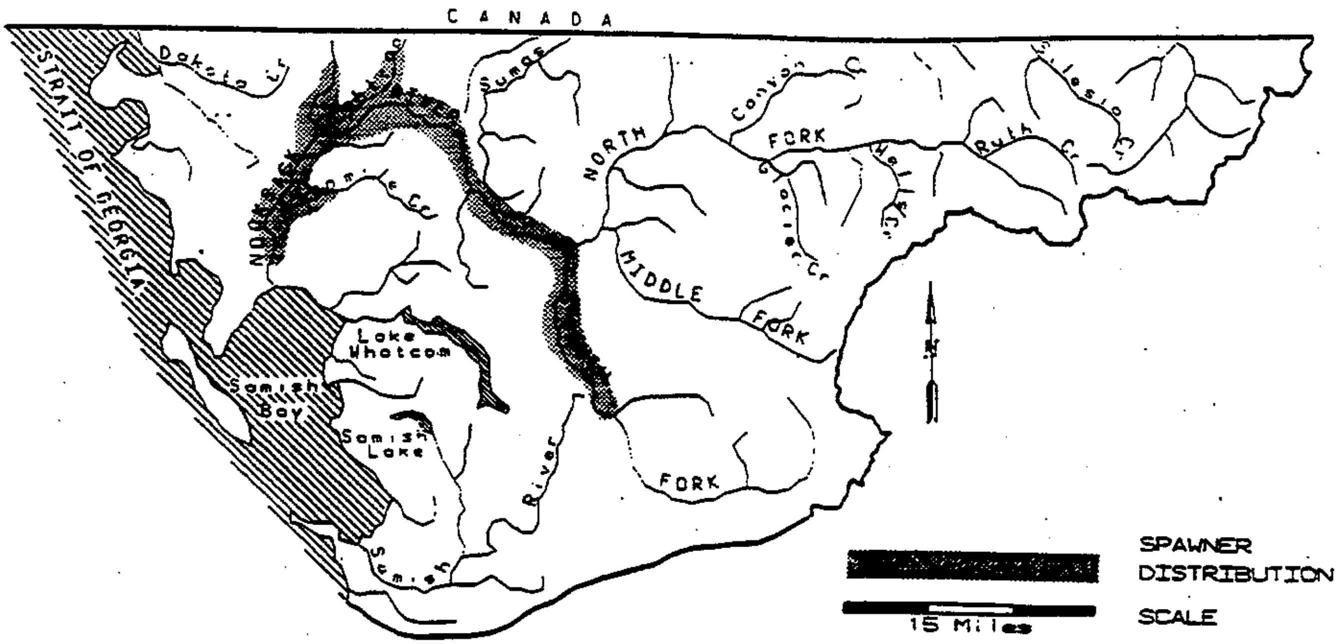
STOCK STATUS

The status of the stock is Unknown.

Estimated total annual returns of Nooksack chum over the last ten years have ranged from 35,000 to 130,000. The great majority of these are wild fish with hatchery and off-station releases contributing small numbers. Estimated escapements of natural spawners have ranged from 10,000 to 40,000. These figures are for the entire drainage but are based on annual comparisons of spawning ground counts taken in the North Fork. The contribution of chum from the South Fork and the mainstem tributaries is unknown. Indexes have recently been established on mainstem tributaries, but no comparative data are available. The numbers of spawners observed are low.

STOCK DEFINITION PROFILE for Mainstem/SF Nooksack Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													UNK
RIVER ENTRY													UNK
SPAWNING													UNK

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

GENETICS - No GSI data for this specific stock. (See: North Fork Nooksack River stock).

STOCK STATUS PROFILE for Mainstem/SF Nooksack Fall Chum

STOCK ASSESSMENT

DATA QUALITY------> Unknown

Return Years	NO DATA			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

NOOKSACK/SAMISH -- SAMISH/INDEPENDENT FALL CHUM

STOCK DEFINITION AND ORIGIN

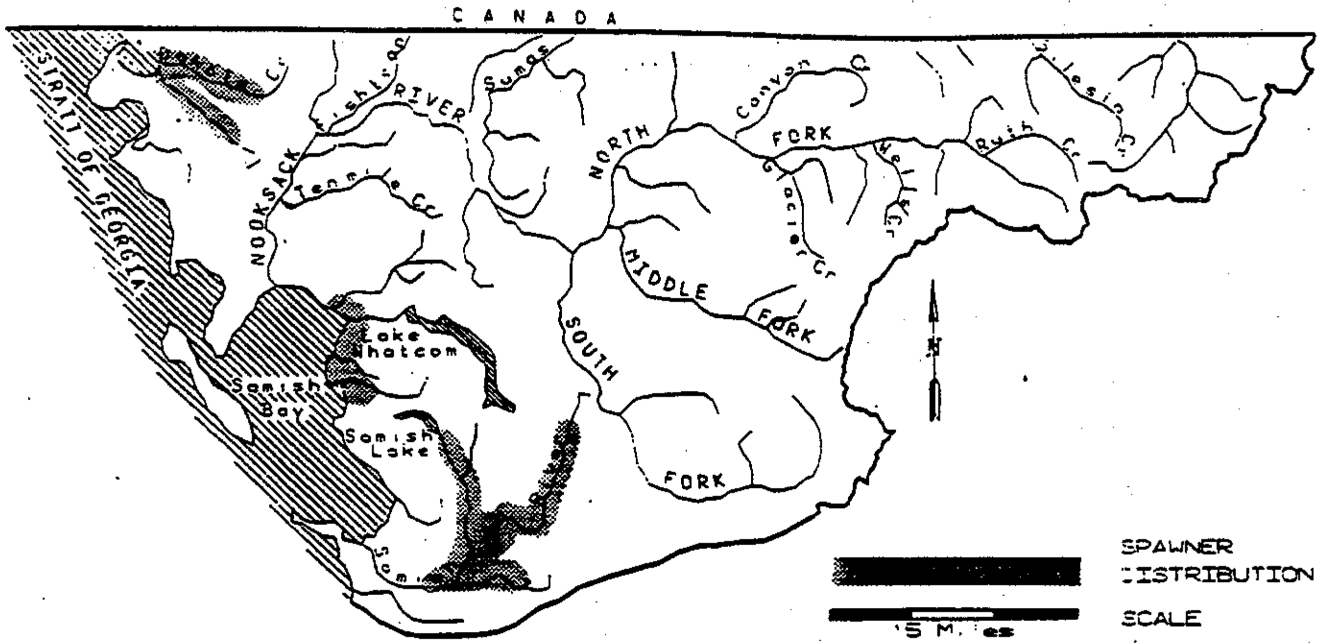
Chum salmon spawning in the small streams entering Samish and Bellingham Bays are grouped with Samish River chum as a single stock. These streams include Colony, Oyster, Chuckanut, Padden, Whatcom and Squalicum creeks. Chum in Dakota and California creeks to the north are tentatively included here pending further investigation. This group is separated geographically from all other chum stocks except those in the Nooksack. It is separated from other northern Puget Sound stocks including the Nooksack stocks, by timing differences and genetics. Chum begin entering many of these streams in late October if there is sufficient flow. Spawning begins soon after and may continue through late December. Peak spawning occurs from mid-November to early December with some variation. Spawning in Samish tributaries tends to follow a similar timing, but timing of spawning in the mainstem has not been documented.

This stock is apparently a hybrid of native chum and chum of Hood Canal Hatchery-origin. The Samish Hatchery spawned chum for much of the first half of this century but in more recent years the production has been essentially by natural spawning. Naturally-spawning chum have also been documented for years in Chuckanut, Oyster, and Colony creeks. Chum eggs were imported to Samish Hatchery at least as early as 1916. In more recent years, Hood Canal and Quilcene chum have been released into the Samish River, Lummi Bay, and Chuckanut, Oyster, Whitehall (Colony tributary), and Dakota creeks. Samish River chum apparently containing a Hood Canal Hatchery genetic component were taken to Whatcom Creek where they are successfully established at the Bellingham Marine Heritage Center Hatchery and have been used for enhancement purposes at other sites in the Bellingham Bay area including Padden and Baker (Squalicum tributary) creeks. Also, large numbers of Grays Harbor chum were introduced into the Samish between 1914 and 1920. North Fork Nooksack and Garrison Springs chum have also been introduced into the geographic area included here.

GSI analysis shows that Samish and Whatcom Creek chum are genetically similar. This stock is distinct but is closer genetically to Hood Canal Hatchery chum than to other northern Puget Sound chum stocks which indicates a strong Hood Canal ancestry. Whether this is due to the recent introductions, earlier introductions or is the result of natural relationships is unknown. There is a possibility that native chum in Chuckanut Creek and perhaps other streams had unique biological characteristics. Chum present prior to the recent introductions of Hood Canal chum appeared to have a distinct appearance. There is some genetic evidence to suggest that refuges of native stocks may still exist, but this requires further investigation.

STOCK DEFINITION PROFILE for Samish/Independent Tribs Fall Chum

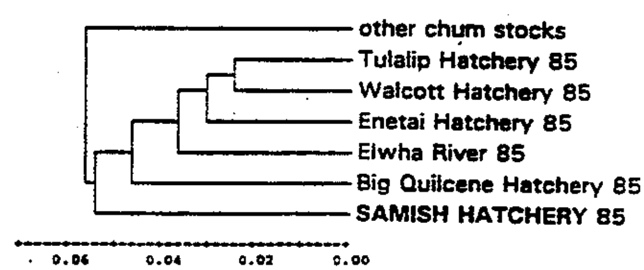
SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY													**UNK**
SPAWNING													**UNK**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Fish from the Samish Hatchery were GSI sampled in 1985 and 1991, (N=100 each year). Analysis of 1985 data indicates that Samish Hatchery fish are significantly distinct from all other Washington and Canadian collections (21-locus G-tests: $p<0.05$). This distinctiveness may be caused by a past mixing of Hood Canal origin chum and the local chum stock.



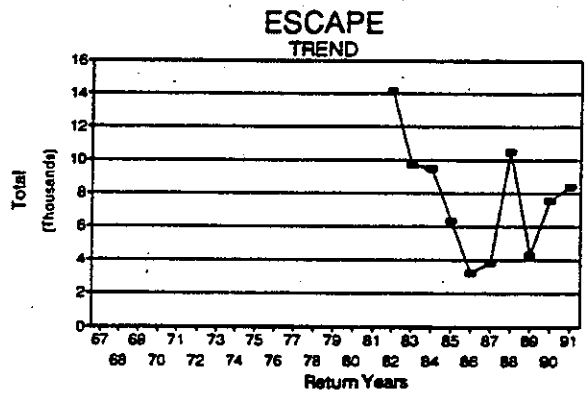
Genetic distance (modified Rogers distance (Wright, 1978); UPGMA)

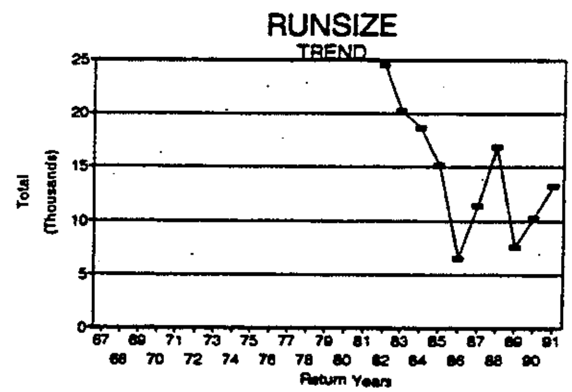
STOCK STATUS PROFILE for Samish/Independent Fall Chum

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total	RUNSIZE Total		
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82	14158	24522		
83	9703	20257		
84	9472	18652		
85	6330	15206		
86	3248	6529		
87	3877	11425		
88	10482	16879		
89	4275	7560		
90	7532	10277		
91	8362	13257		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Mixed

PRODUCTION TYPE
Composite

STOCK DISTINCTION
Distribution, Genetic

STOCK STATUS
Healthy

SCREENING CRITERIA

STOCK STATUS

The status of the stock is Healthy based on trends in spawner escapement.

Returning numbers of Samish River chum (hatchery and wild) for the last ten years have ranged from 190 to 19,000; returns to the independent streams including Whatcom Creek have ranged from 4,700 to 13,000. Escapement estimates range from 93 to 1,100 for the Samish and 3,200 to 8,000 for the other streams. Estimated total returns are calculated from escapement estimates and harvest data and do not include Canadian interceptions. Escapement estimates are based on cumulative spawning ground counts and total hatchery rack counts. Spawning ground counts in the mainstem Samish are particularly difficult because of poor visibility, and fish may avoid the hatchery rack during high flow, so Samish figures are not very reliable. The lowest figures in the escapement and return ranges were for the 1986 return which was evidently affected by catastrophic localized flooding in 1982 when eggs were being incubated. Chuckanut, Oyster, and Whitehall creeks are surveyed regularly, and conditions generally favor reliable counts.

OVERVIEW -- NOOKSACK/SAMISH COHO STOCKS

NOOKSACK
SAMISH
NORTH PUGET SOUND TRIBS

STOCK DEFINITION AND ORIGIN

The criterion for separation of these groups of salmon is geographic distribution of spawning as observed in spawner surveys which have been conducted at specific locations within each of the watersheds (WDF Salmon Spawning Ground Data Retrieval system). The nature of the available data does not permit determination of clean geographic boundaries since the data relate to discrete survey locations and not to the continuum of geographic distribution. Timing and morphological differences between the groups of fish either do not exist or have not been observed. Analysis for differences in genetics by electrophoresis is feasible though less satisfactory for coho than for other salmon. This type of analysis has not been performed for the groups of naturally-spawning coho in the Nooksack, Samish, independent north Sound drainages or for the dominant groups of hatchery introductions which have been made. Based on geographic distribution alone, stocks should be named for each of the independent drainages into Drayton Harbor and Chuckanut Bay. The available data thus leave the question of the status of these groups as stocks unresolved. Studies of stray rates and/or genetics will be required to resolve conflicting technical opinions in the issue.

For convenience, the coho spawning in the Nooksack River and its tributaries have been listed as a stock, those spawning in the Samish River have been listed as a second stock, and those spawning in the independent tributaries to North Puget Sound have been listed as a third stock.

Naturally-spawning components in the Nooksack River, Samish River, and independent drainages are not distinguishable in spawning time (late October through mid-January) from each other or from the dominant source of hatchery coho in the region (annual releases of five to seven million hatchery fish).

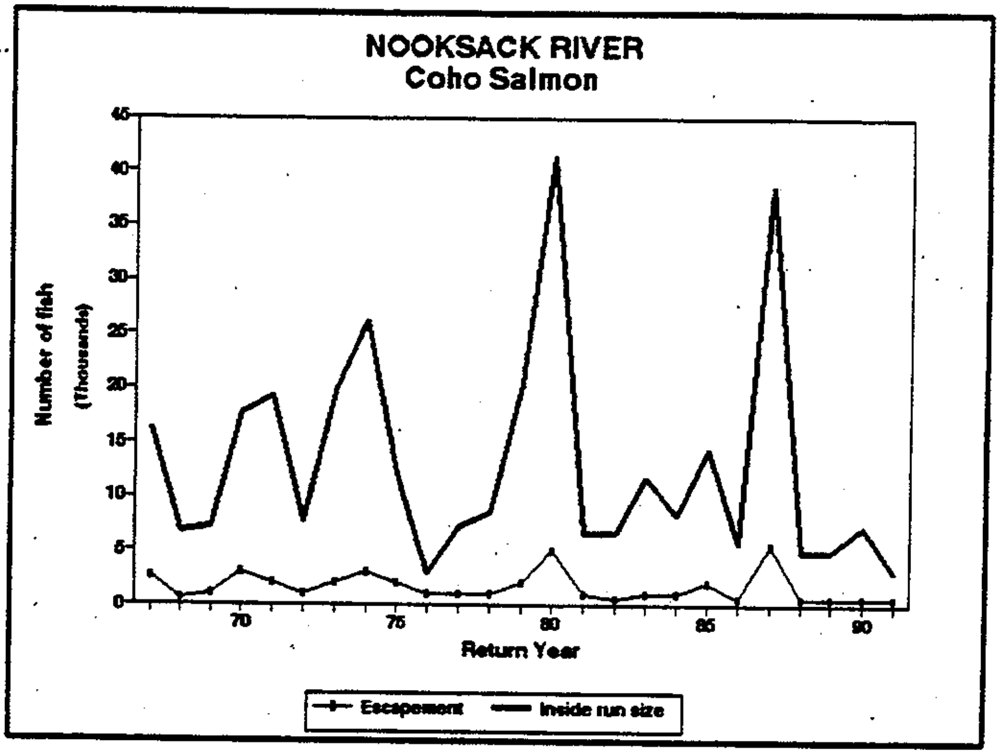
The Samish Hatchery (Friday Creek) was established in 1899. Early hatchery records (1913-1919) indicate that non-native coho were brought into the hatchery and released. A continuous hatchery program for coho on the Samish was carried out until 1977 using what was probably a hybrid stock. There were also on- and off-station releases of Skagit (1961, 1972, 1975, 1976, 1977, 1979), Skykomish (1976), Green River (1955, 1956), Pilchuck (1977), and Big Beef (1977) stocks in the basin. The coho program at Samish was discontinued in 1978. Although no estimates of potential straying from the Nooksack or other basins have been made, the stock is apparently maintaining itself by natural production.

In response to extreme habitat degradation in the Nooksack basin, a large hatchery program was initiated at the Nooksack Hatchery on Kendall Creek. From 1952 to present, yearling releases from the Nooksack Hatchery on Kendall Creek have exceeded a million fish annually. Since 1952, the majority of hatchery-origin coho into the Nooksack River basin have been Nooksack fish. Non-local hatchery coho have come principally from Samish, Skagit (including Clark Creek) and Skykomish stocks. Hatchery fish from Hood Canal, Green River and Lake Creek (Sol Duc) have also been released into the Nooksack system, although to a lesser extent. In eight of the 41 years from 1952 to 1992, releases of non-local stocks exceeded release of local stocks in the Nooksack system. From 1969 to present, yearling releases have also occurred from Skookum Creek Hatchery and Lummi Bay Hatchery, both operated by the Lummi Nation. In recent years these releases have been from two to three million annually. For the past ten years, hatchery releases of "Nooksack stock" yearlings and fry/egg plants into various parts of the river systems have typically been from five to seven million fish annually. Sources of spawning fish and eggs and sites of off-station releases have involved some "Nooksack stock" but have differed from year-to-year. These large, continued, and varied introductions of hatchery fish principally from the Nooksack, Samish, Skagit, and Skykomish rivers in various mixes have contributed heavily to the composition of coho stocks in this region. Studies of hatchery and wild stock straying, as well as electrophoretic analyses of tissues from fish from the hatcheries and wild spawning grounds in the Nooksack, Samish, and independent tributaries are urgently needed to better define stocks and their origins.

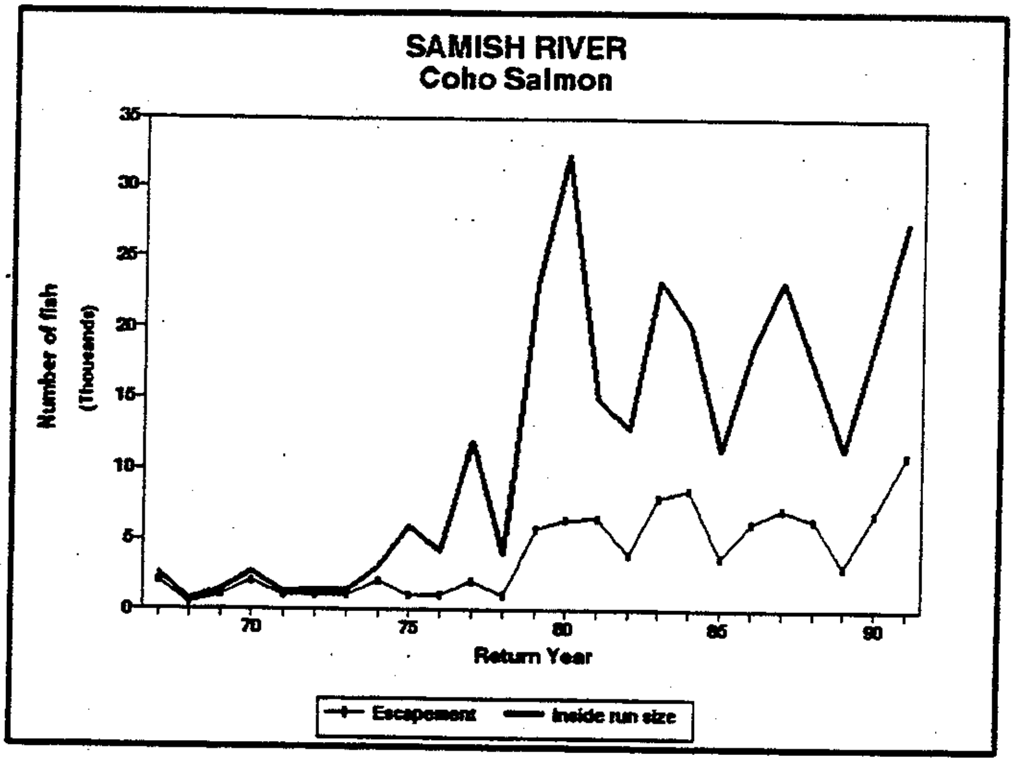
STOCK STATUS

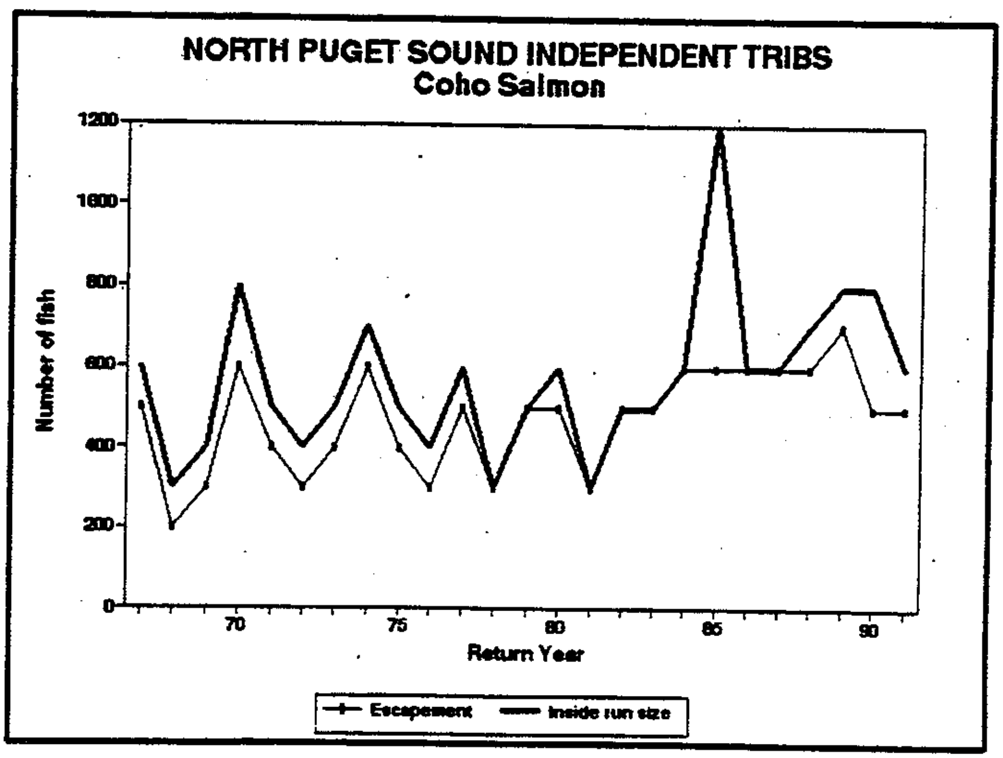
Wild spawning has been observed throughout the anadromous zone of the Nooksack River and its tributaries; the Samish River and its tributaries; Dakota and California creeks in Drayton Harbor and Chuckanut, Oyster and Colony creeks in Chuckanut Bay. In the Nooksack, natural escapements have been estimated to range from 500 to 5,500 since 1966 based on spawner surveys conducted at a limited number of discrete sites within the system. There has been no evidence that these fish differ biologically from the dominant hatchery fish. Indeed, the highest escapement in this period (1987) corresponds to the second highest hatchery release to the system (6.2 million in 1985) over this same period. Natural spawning in the Samish River and tributaries also occurs throughout most of the anadromous zone. Natural spawning escapements have ranged from 500 to 11,000 between 1967 and the present. The magnitude of these estimated escapements also corresponds somewhat to Nooksack River hatchery releases. Total estimated escapement for California, Dakota, Chuckanut, Oyster and Colony creeks has ranged from 200 to 700 since 1967 with no obvious trends in numbers related to releases.

Coho salmon of the Nooksack, Samish, Drayton Harbor, and related drainages are dominant Puget Sound contributors to Canadian and U.S. sport and commercial fisheries. The fish have been managed as a hatchery management unit under the Puget Sound Salmon Management Plan for nearly 20 years.



More information on each stock is presented in separate Stock Reports.


SAMISH RIVER
Coho Salmon
Number of fish (Thousands)
Return Year
Escapement
Inside run size


NORTH PUGET SOUND INDEPENDENT TRIBS
Coho Salmon
Number of fish
Return Year
Escapement
Inside run size

NOOKSACK/SAMISH -- NOOKSACK COHO

STOCK DEFINITION AND ORIGIN

This stock does not display any documented unique temporal distribution (spawning from late October to mid-January throughout the system) or biological characteristics. We believe that there is no significant interchange of spawners (straying) between the Nooksack River system and the surrounding drainages, so this stock has been defined by its distinct spawning distribution. Historically, there may have been multiple stocks within this broad drainage. However, given the probable impacts of introduction of a variety of non-native stocks, there is no justification for supposing that significant differences exist within the watershed at this time.

Yearling coho have been released annually into Kendall Creek since 1952, with release numbers approaching or exceeding one million since 1970. Nooksack stock has been utilized in all years and Skagit-origin fish were released as well in 1960 through 1992. Substantial yearling releases have been made into most of the significant tributaries in this system, primarily from the early 1950s to the mid-1960s. These releases were predominantly Nooksack and Samish stock. Additionally, Nooksack, Skagit and Samish stock fry and fingerlings have been distributed throughout the drainage. There has also been significant Lummi Tribal coho production in this drainage. Since the beginning of the Sea Pen program in the early 1970s, total tribal coho yearling production from the pens and the Skookum Creek Hatchery has grown to an annual release of about two million. These two programs have utilized a variety of stocks, including Baker (Skagit), Nooksack, Skagit, Skykomish and Dungeness. In 33 of the 41 years from 1952 through 1992, non-local hatchery coho releases comprised less than half of the total hatchery coho releases in the Nooksack basin (range 0% - 44.6%). In the remaining eight years, non-local releases accounted for more than half of the total hatchery coho releases. The highest percentage of non-local releases, 84.4% of total releases, came in 1982. Assuming some significant survival to spawning of the off-station releases and some contribution of hatchery returns to the naturally spawning population in this system, the current stock should be classified as a mixture of the native and the introduced non-native stocks.

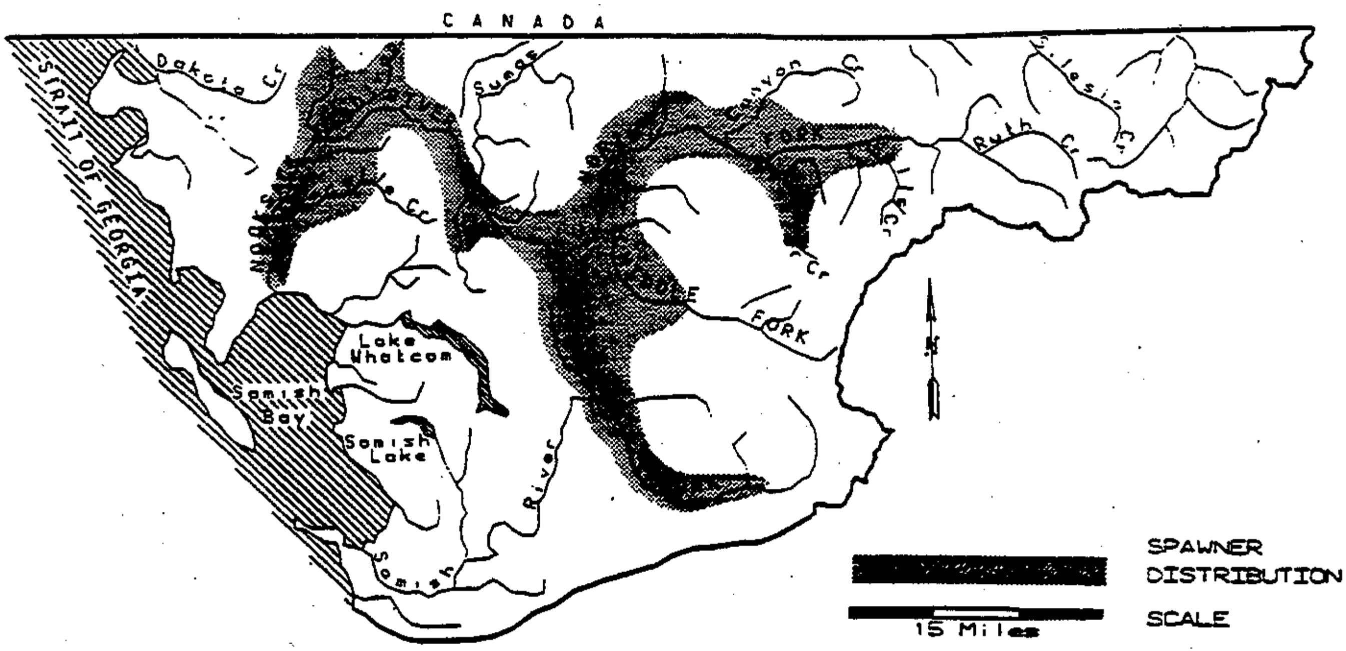
STOCK STATUS

The status of the stock is Unknown due to uncertainty about whether spawners are produced naturally or result from hatchery releases.

Run reconstruction data (escapement estimates and Puget Sound run-sizes) are available as well as the index peak spawner data from which they are derived. The base spawner survey data are probably the weakest in Puget Sound due to a lack of

STOCK DEFINITION PROFILE for Nooksack Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													UNK
RIVER ENTRY													UNK
SPAWNING													UNK

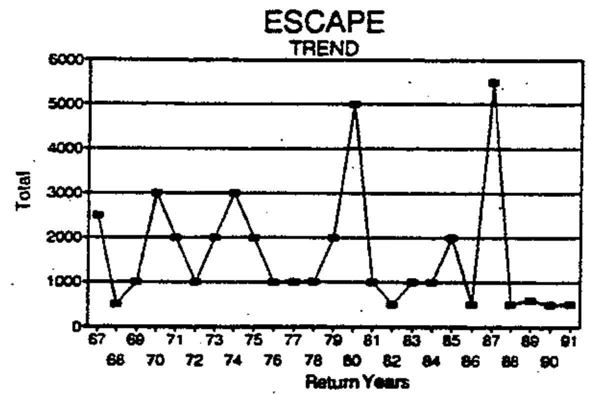
BIOLOGICAL CHARACTERISTICS
DISTINCT? - **NO**

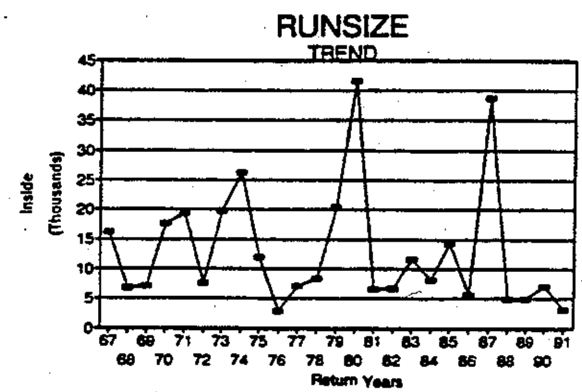
STOCK STATUS PROFILE for Nooksack Coho

STOCK ASSESSMENT

DATA QUALITY------> Fair

Return Years	ESCAPE Total	RUNSIZE Inside		
67	2500	16200		
68	500	6800		
69	1000	7200		
70	3000	17700		
71	2000	19300		
72	1000	7600		
73	2000	19700		
74	3000	26200		
75	2000	12000		
76	1000	2900		
77	1000	7200		
78	1000	8400		
79	2000	20500		
80	5000	41500		
81	1000	6600		
82	500	6700		
83	1000	11700		
84	1000	8200		
85	2000	14400		
86	500	5700		
87	5500	38600		
88	500	4900		
89	600	4900		
90	500	7200		
91	500	3200		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Mixed

PRODUCTION TYPE

Composite

STOCK DISTINCTION

Distribution

STOCK STATUS

Unknown

SCREENING CRITERIA

survey consistency. Good quality data are available since 1980 with some deficiencies in 1989 and 1990. Currently the run reconstruction data probably best represent the relative production of this stock.

Escapement in this system has been substantially below the goal of 9,000 adults over the entire database (1965-1991) and, with the exception of 1987, escapements since 1986 equal the lowest on record.

FACTORS AFFECTING PRODUCTION

Habitat -- In addition to the natural and human-caused sedimentation in the upper watershed, coho salmon are also limited by summer low flows in the mainstems and tributaries. In the middle to lower watershed, agricultural practices of stream dredging and clearance of shade and cover-producing riparian vegetation and instream large woody debris has diminished the carrying capacity of these streams. High stream temperatures, farm chemical and manure pollution may also reduce water quality. Wetland habitats, especially in the diked areas in the lower river, have been blocked or drained reducing the availability of juvenile overwinter habitat. About 21 miles of habitat have been blocked or pose significant obstacles to adult coho because of culverts and small dams.

Harvest Management -- Nooksack River coho are primarily harvested in Canadian troll, net and sport fisheries and in Washington net and sport fisheries. In the 1988-1990 time period, 56% of the harvest occurred in Canadian fisheries and 44% in Washington fisheries. In the preterminal areas, the harvest rates on Nooksack River coho are determined by the needs of other stocks of coho or by other species. In the terminal area, Bellingham Bay and the Nooksack River, the harvest rate for Nooksack River coho is set to take the full hatchery surplus.

The total harvest rate on Nooksack River coho in the 1988-1990 period was approximately 95%, although uncertainties in estimating escapement make this harvest rate estimate less precise than for most other Puget Sound stocks. Although marine survival cannot be measured for the naturally-produced coho from the Nooksack River, it is probable that this harvest rate is well above the optimum for this stock.

Hatchery -- Nooksack Hatchery is located 21.0 miles NE of Bellingham on the Mount Baker Highway. The original station was constructed in 1899, with many improvements added since that time. Current release numbers for the station are 5.0 million chinook and 1.3 million coho and 400,000 chum. Eyed egg capacity at the hatchery is approximately 20.7 million. Hatching capacity (includes some pond incubation) is 14.4 million salmon fry.

Last ten years salmon releases into the Nooksack basin.

Release Year	Spring Chinook	Fall Chinook	Chum	Coho
1982	0	14576579	877660	8339325
1983	130530	14603809	1558068	4785671
1984	24727	12875503	1972960	5746554
1985	209071	10373058	407000	8888736
1986	315835	6382537	1470832	8536671
1987	267600	12453174	1417100	4403619
1988	94591	7777611	582475	5905826
1989	1468184	5191900	2002700	5771161
1990	1124918	9073463	2144100	4250096
1991	355069	6085398	3747900	2881940
MEAN	443392	9939303	1618080	5950960

Coho production is 1,300,000 yearling smolts released on-station with up to 2,000,000 coho fry being planted off-station into tributaries of the Nooksack River. Additionally, the hatchery provides approximately 1,500,000 coho eggs for co-op projects.

Hatchery operational impacts have not been determined. There are several hatchery coho and chinook rearing and release programs on this river system.

NOOKSACK/SAMISH -- SAMISH COHO

STOCK DEFINITION AND ORIGIN

This stock was designated on the basis of distinct geographical spawning distribution. These fish have no documented distinct biological characteristics and have no clearly distinct temporal distribution (spawning from late October through mid-January). It is believed that no, or minimal, straying from other basins is occurring. However, separation from other stocks is still tentative pending genetic study.

Based on the following information, the current stock is presumed to be of mixed origin. Early records (1913-1919) indicate non-native coho have been brought into the Samish Hatchery (established in 1899) on Friday Creek and subsequently released. Assuming survival to adult of these hatchery releases, the hatchery stock was a hybrid until the hatchery coho program was discontinued in 1977. There were also on and off-station releases of Skagit (1961, 1972, 1975, 1976, 1977, 1979), Skykomish (1976), Green River (1955, 1956), Pilchuck (1977), and Big Beef (1977) stocks in the basin. Currently, the stock is sustaining itself with natural production.

STOCK STATUS

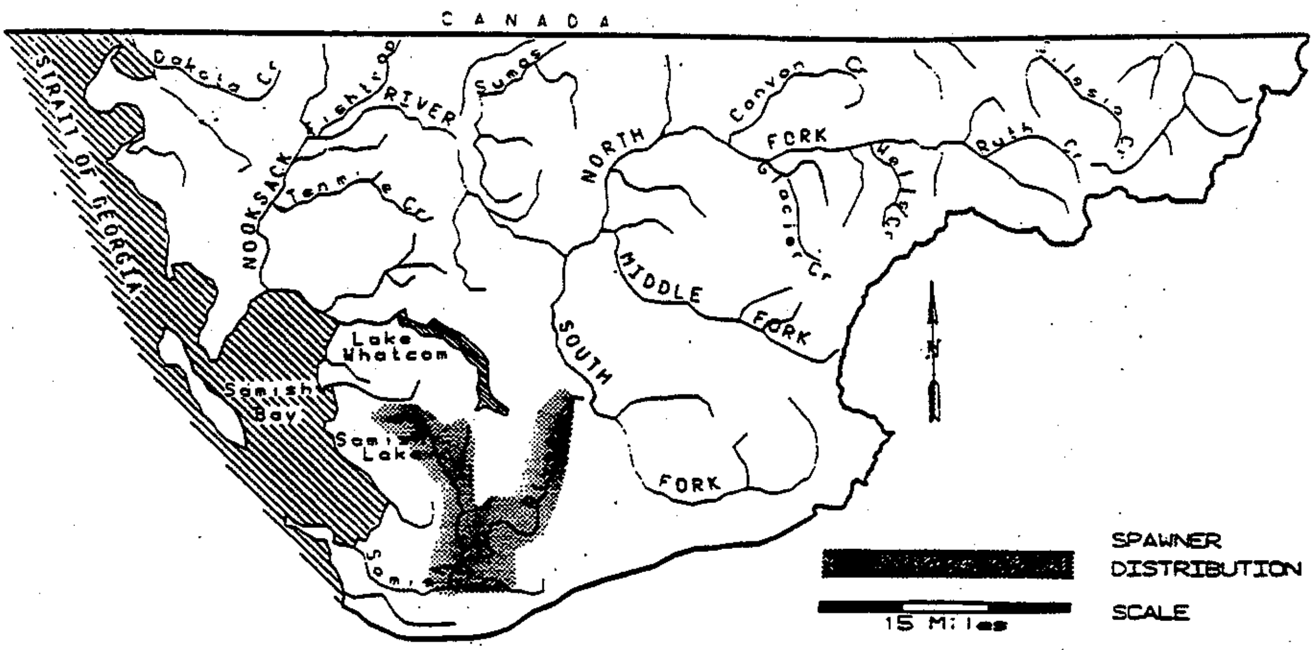
The status of the stock is Healthy based on trends in spawning escapement.

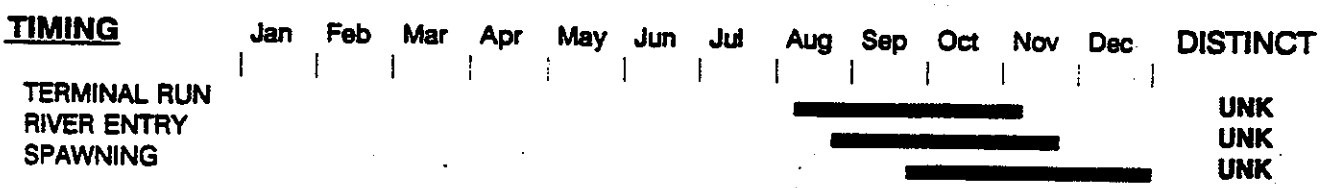
The long-term escapement estimates indicate a stable stock, which is encouraging in light of substantial basin habitat degradation. In the short-term, 1991 (11,000 estimate) had the highest escapement estimate in the database. The range of escapements has been between 1,000 and 11,000 fish.

Run reconstruction data (escapement estimates and Puget Sound run-size) are available and best represent this stock's production trend. Samish coho utilize all the accessible tributaries and mainstem of the basin, including those entering Samish Lake. The spawner survey data from the four indexes are good from 1977 to the present. Accurate upstream counts have been made yearly at the hatchery weir at RM 10.5. These yearly counts have served as the escapement estimate basis, modified by tributary index spawning counts due to early cutoff (December 1) of rack counting or flooding conditions.

STOCK DEFINITION PROFILE for Samish Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**





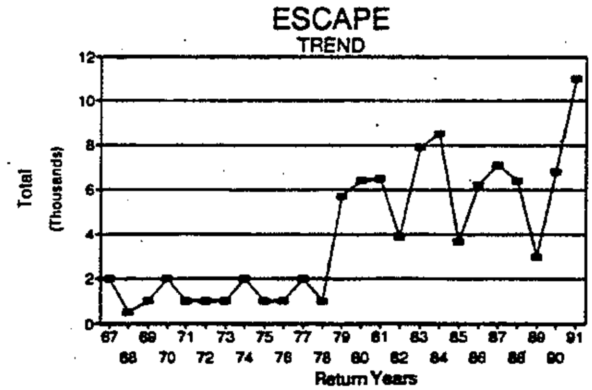
BIOLOGICAL CHARACTERISTICS
DISTINCT? - **NO**

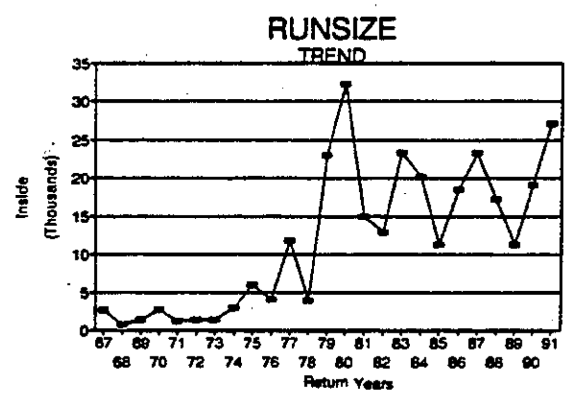
STOCK STATUS PROFILE for Samish Coho

STOCK ASSESSMENT

DATA QUALITY------> NOT AVAILABLE

Return Years	ESCAPE Total	RUNSIZE Inside		
67	2000	2600		
68	500	700		
69	1000	1300		
70	2000	2700		
71	1000	1200		
72	1000	1300		
73	1000	1300		
74	2000	3000		
75	1000	6000		
76	1000	4100		
77	2000	11900		
78	1000	3900		
79	5700	23000		
80	6400	32300		
81	6500	15000		
82	3900	12900		
83	7900	23400		
84	8500	20200		
85	3700	11300		
86	6200	18600		
87	7100	23400		
88	6400	17300		
89	3000	11300		
90	6800	19100		
91	11000	27100		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Mixed

PRODUCTION TYPE

Composite

STOCK DISTINCTION

Distribution

STOCK STATUS

Healthy

SCREENING CRITERIA

NOOKSACK/SAMISH -- NORTH PUGET SOUND TRIBS COHO

STOCK DEFINITION AND ORIGIN

This stock was designated on the basis of geographic spawning distribution. This composite stock does not exhibit any unique spawning or run-timing (spawning from mid-November to mid-January), or any distinct biological characteristics. We believe minimal straying to these independent streams occurs. Separation from other stocks is tentative, pending genetic study.

Based on the following information, stock origin is classified as a mixed, hybrid of native fish and introduced hatchery stocks. Non-local coho stocks have been released in the independent tributaries, mostly of Samish origin, although Green River (1956), Skagit (1978), and Nooksack (1979) stock have been used. Plantings of non-local yearlings, fingerlings, and/or unfed fry were made in 1951-1953, 1954-1957, 1960, 1961-1964, 1968, 1971, 1977, and 1978. Also, remote egg boxes currently produce non-local fry for those tributaries. We are assuming some survival to spawning of these stocks and subsequent mating with native fish.

STOCK STATUS

The status of the stock is Unknown.

Based on the run reconstruction data, this stock's performance has been relatively stable since 1982. However, Dakota Creek basin contributes the most to this stability, and the other tributaries consistently have small populations.

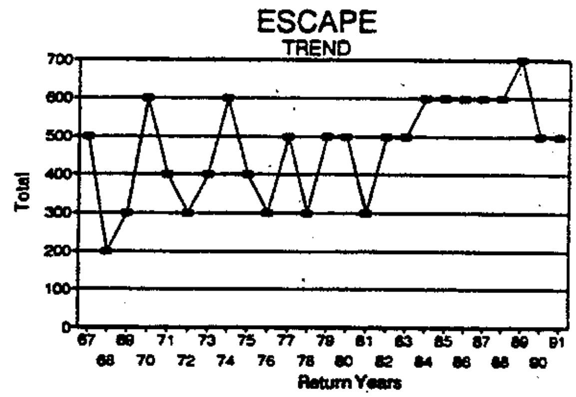
A yearly run reconstruction accounting contains escapement estimates and Puget Sound run-size for this stock. Also, index spawner data are available. The run reconstruction data best reflect this stock's production trend. The base spawner data are good for each of the independent tributaries (Dakota, California, Chuckanut, Oyster, and Colony creeks) since 1984. However, yearly coverage prior to 1984 is erratic.

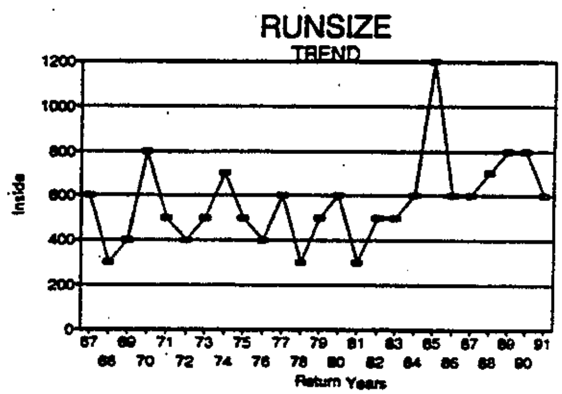
STOCK STATUS PROFILE for North Puget Sound Tribs Coho

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Total	RUNSIZE Inside		
67	500	600		
68	200	300		
69	300	400		
70	600	800		
71	400	500		
72	300	400		
73	400	500		
74	600	700		
75	400	500		
76	300	400		
77	500	600		
78	300	300		
79	500	500		
80	500	600		
81	300	300		
82	500	500		
83	500	500		
84	600	600		
85	600	1200		
86	600	600		
87	600	600		
88	600	700		
89	700	800		
90	500	800		
91	500	600		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Mixed

PRODUCTION TYPE
Wild

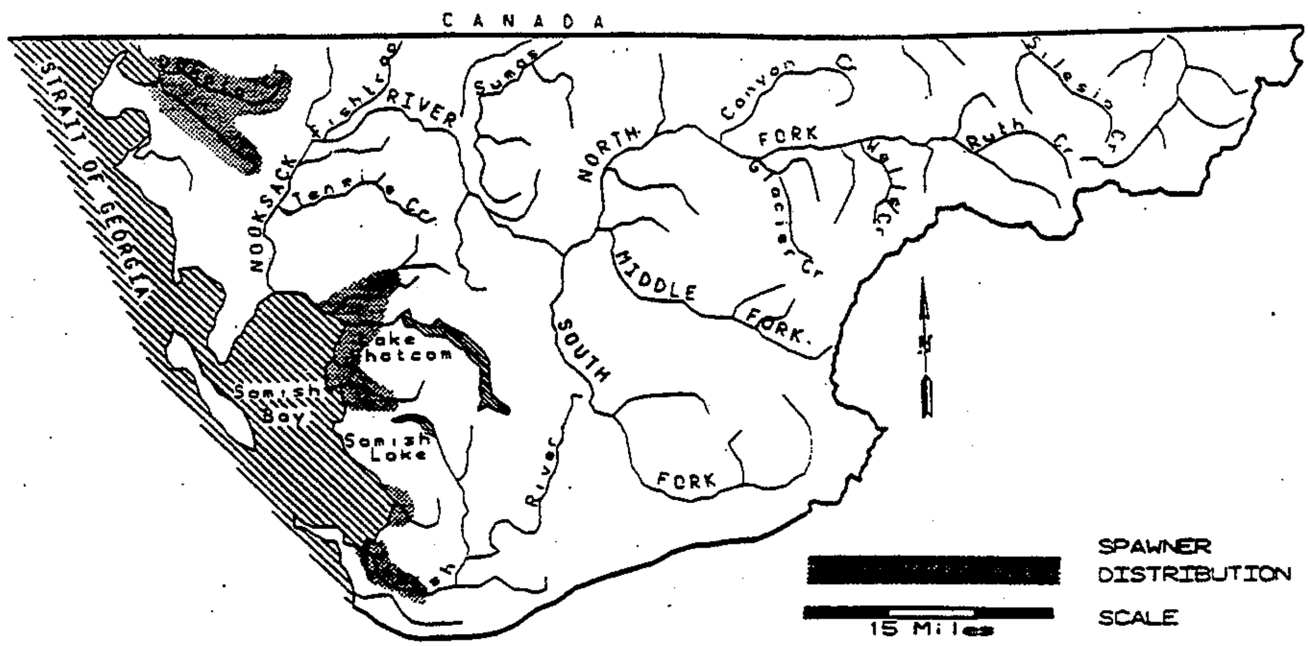
STOCK DISTINCTION
Spawn Distribution

STOCK STATUS
Unknown

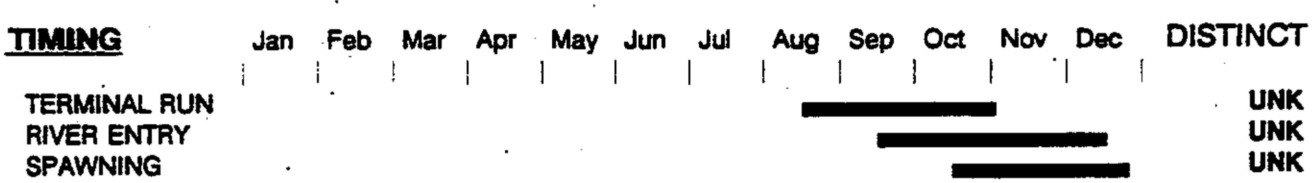
SCREENING CRITERIA

STOCK DEFINITION PROFILE for North Puget Sound Tribs Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

OVERVIEW -- NOOKSACK/SAMISH PINK STOCKS

NORTH FORK/MIDDLE FORK NOOKSACK
SOUTH FORK NOOKSACK

STOCK DEFINITION AND ORIGIN

Nooksack pink salmon enter the river in July and August with a peak entry time in late July. Spawning begins in August and peaks in mid-September. There is no distinguishable difference in entry or spawning time between groups of pink salmon which spawn at different places in the Nooksack system. Nooksack pink salmon return in odd years only.

Pink salmon spawn in the mainstem and accessible tributaries on the North Fork, Middle Fork and South Fork. Thompson Creek on the North Fork has had consistently high numbers of spawners. Spawning in the South Fork extends up to River Mile 25 and includes accessible tributaries.

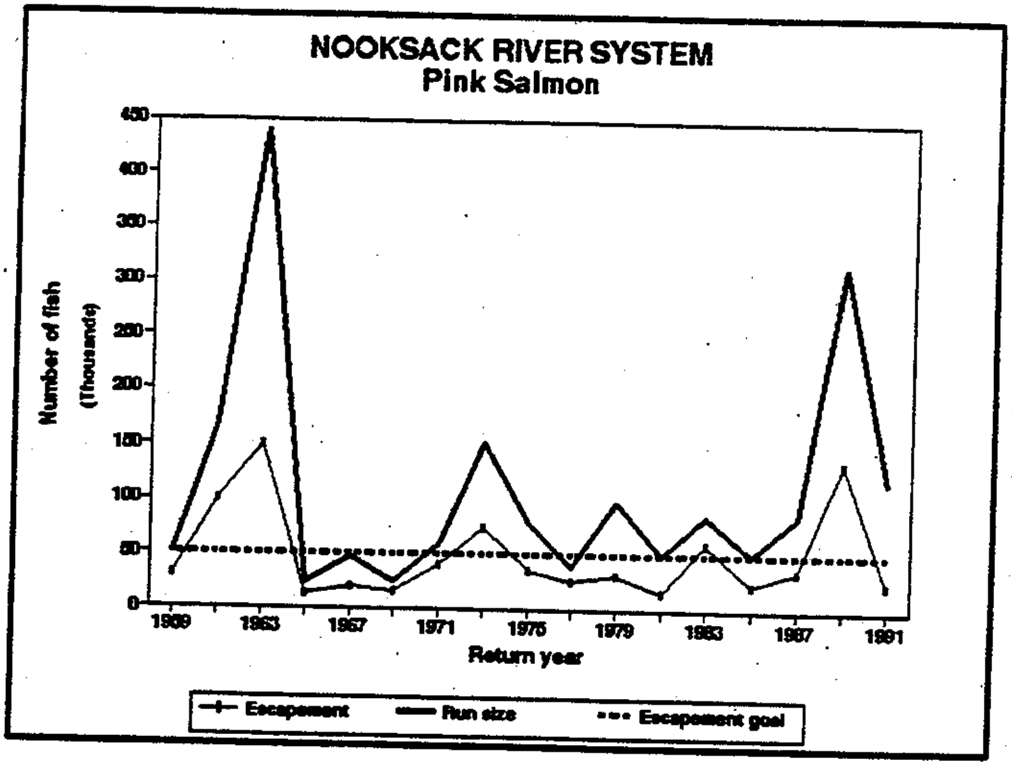
Nooksack pink salmon are separated from other pink stocks geographically and genetically. The source of fish used for genetic analysis in the Nooksack River was the North Fork and the Middle Fork. Data for fish collected in other portions of the system have not been analyzed. It is presently uncertain if the South Fork stock is truly separate from the North Fork/Middle Fork stock. Genetic analysis will be required to answer this question.

Pink salmon were native to the Nooksack River. However, recent genetic analysis of fish taken from the North and Middle Forks showed them to be similar to Hood Canal hatchery stock which was initially derived from eggs imported from the Dungeness River.

STOCK STATUS

The estimated annual total number of returning Nooksack pink salmon has ranged from 39,000 to 320,000 for 1973 through 1991 with escapement estimates ranging from 15,000 to 138,000 (see figure). Production from all forks is included in these figures. Estimated total returns are calculated from escapement estimates and harvest data, and include Canadian interceptions. Escapement estimates are based on a comparison of spawning ground counts in designated index areas to counts for the same areas made during 1959, 1961, and 1963 when escapements were determined by tagging studies. The accuracy of these estimates is unknown because there have been changes in habitat and spawner distribution since the tagging studies were conducted. However, their value for showing trends is good because of consistency in survey methods and personnel.

More information on each stock is presented in separate Stock Reports.


NOOKSACK RIVER SYSTEM
Pink Salmon
Number of fish
(Thousands)
450
400
350
300
250
200
150
100
50
0
1959
1963
1967
1971
1975
1979
1983
1987
1991
Return year
Escapement
Run size
Escapement goal

NOOKSACK/SAMISH -- NORTH FORK/MIDDLE FORK NOOKSACK PINK

STOCK DEFINITION AND ORIGIN

Pink salmon spawning in the North and Middle Forks of the Nooksack are considered to be a distinct stock because of geographical separation from other pink salmon stocks. GSI analysis confirms that this stock is distinct from other Washington pink stocks. The pink salmon that spawn in the South Fork of the Nooksack are considered here to be distinct because of geographical separation and possible differences in spawning timing and will be discussed in a separate stock report. GSI characterization of that stock has not yet been accomplished.

Adult pink salmon enter the Nooksack primarily during July and August, peaking toward the end of July. Adults return during odd-numbered years only. Spawning begins in late August, peaks in early to mid-September, and is generally completed by the end of September. Spawning occurs in mainstem areas and accessible tributaries of the North Fork. Thompson Creek has consistently high numbers of spawners. Heavy spawning has also been observed in two unnamed spring-fed tributaries as well as mainstem areas of the Middle Fork.

The North Fork/Middle Fork Nooksack pink salmon have been considered to be a native stock. However, the GSI results indicate that this stock is genetically similar to the Hood Canal hatchery stock which was primarily derived from eggs imported from the Dungeness River. Pink salmon eggs from Hood Canal hatchery were used in an egg box enhancement project on Gallop Creek, a North Fork tributary, in 1977. Whether or not this introduction altered the genetics of the native stock by hybridization is unknown as there are no informative GSI data that predate the egg box project. In any case, the possibility exists that North Fork/Middle Fork Nooksack pinks are actually a hybrid stock.

STOCK STATUS

The status of the stock is Unknown due to state-tribal differences in interpretation of measures of abundance.

The estimated total number of returning Nooksack pink salmon has ranged from 39,000 to 320,000 over the last ten cycles with escapement estimates ranging from 15,000 to 136,000. Production from the South Fork is included in these figures. Estimated total returns are calculated from escapement estimates and harvest data, and include Canadian interceptions. Escapement estimates are based on a comparison of spawning ground counts in designated index areas to counts for the same areas made during 1959, 1961, and 1963 when escapements were determined

STOCK STATUS PROFILE for North/Middle Fork Nooksack Pink

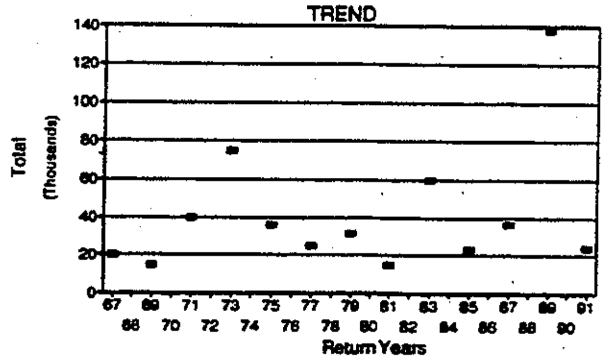
STOCK ASSESSMENT

DATA QUALITY------> Good

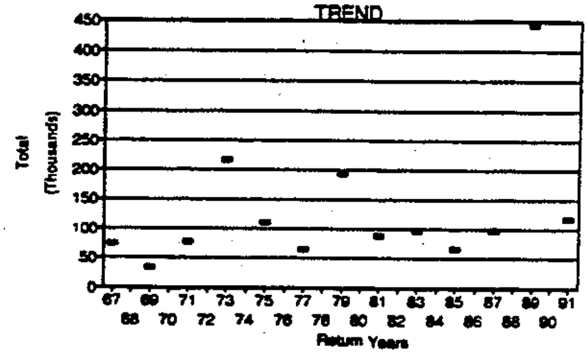
Return Years	ESCAPE Total	RUNSIZE Total		
67	20000	74696		
68				
69	15000	33997		
70				
71	40000	77321		
72				
73	75000	216273		
74				
75	36000	110813		
76				
77	25000	64899		
78				
79	31400	194263		
80				
81	15000	88711		
82				
83	60000	96513		
84				
85	23000	66321		
86				
87	36600 37000	96776		
88			93 56000	
89	137600 136000	443374	95 220000	
90			97 26000	
91	24000	117545	99 95000	

Odd-year returns only.

ESCAPE
TREND



RUNSIZE
TREND



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Mixed

PRODUCTION TYPE
Wild

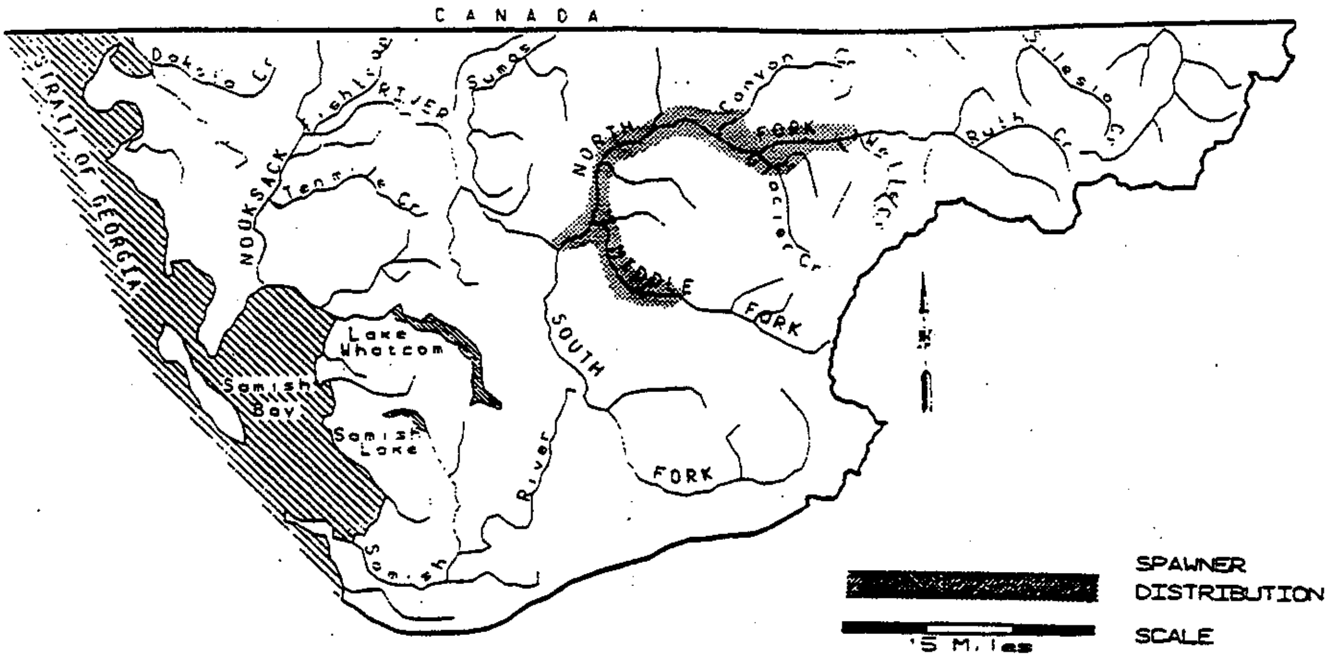
STOCK DISTINCTION
Distribution, Genetic

STOCK STATUS
Healthy

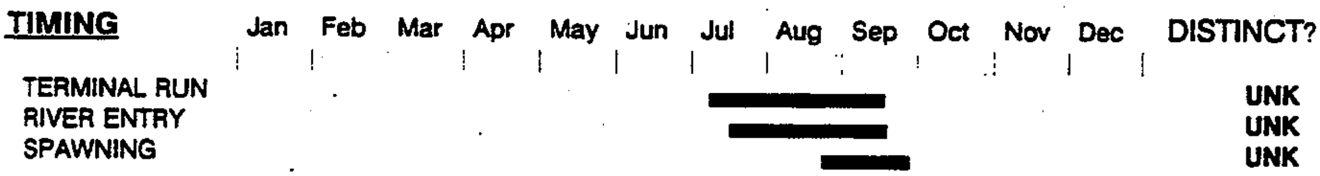
SCREENING CRITERIA

STOCK DEFINITION PROFILE for North/Middle Fork Nooksack Pink

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

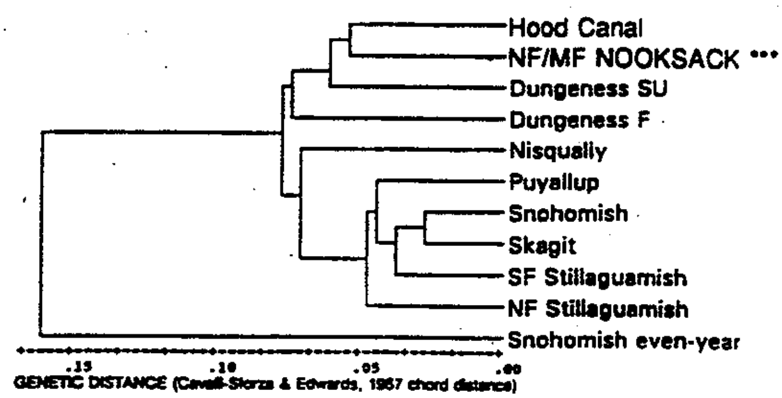


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - This stock is significantly different from all other Washington stocks [collections from Gallop & Thompson creeks & MF Nooksack, (N=302); 28-locus G-tests: **p**<0.001]. Clustering with Hood Canal & Dungeness stocks may reflect past stock introductions into Nooksack.



by tagging studies. The accuracy of these estimates is unknown because there have been changes in habitat and spawner distribution since the tagging studies were conducted. However, the estimate is good for showing trends because of consistency in survey methods and personnel.

NOOKSACK/SAMISH -- SOUTH FORK NOOKSACK PINK

STOCK DEFINITION AND ORIGIN

Pink salmon spawning in the South Fork of the Nooksack are tentatively considered here to be a distinct stock because of geographical separation. Infrequent observations of small numbers of spawners have been made in different parts of the South Fork in different years. There may also be slight differences in spawning timing. GSI analysis has not yet been conducted to determine if South Fork pinks are genetically distinct from pink salmon in the North and Middle forks of the Nooksack.

Adult pink salmon enter the Nooksack primarily during July and August, peaking toward the end of July. Adults return during odd-numbered years only. Spawning in the South Fork and its tributaries begins in early September, peaks in mid- to late September and is generally completed by the end of September. Spawning occurs in the mainstem as far upstream as the cascade at RM 25.0 and in accessible tributaries.

The Nooksack pink salmon stocks have been considered to be of native origin. However, recent GSI data indicate that fish from the North and Middle Forks are genetically similar to the Hood Canal hatchery stock. The review of the North Fork/Middle Fork Nooksack pink stock covers introductions in more detail. Since South Fork pinks have not been tested for genetic relationships it is not known if they have hybridized with introduced stocks.

STOCK STATUS

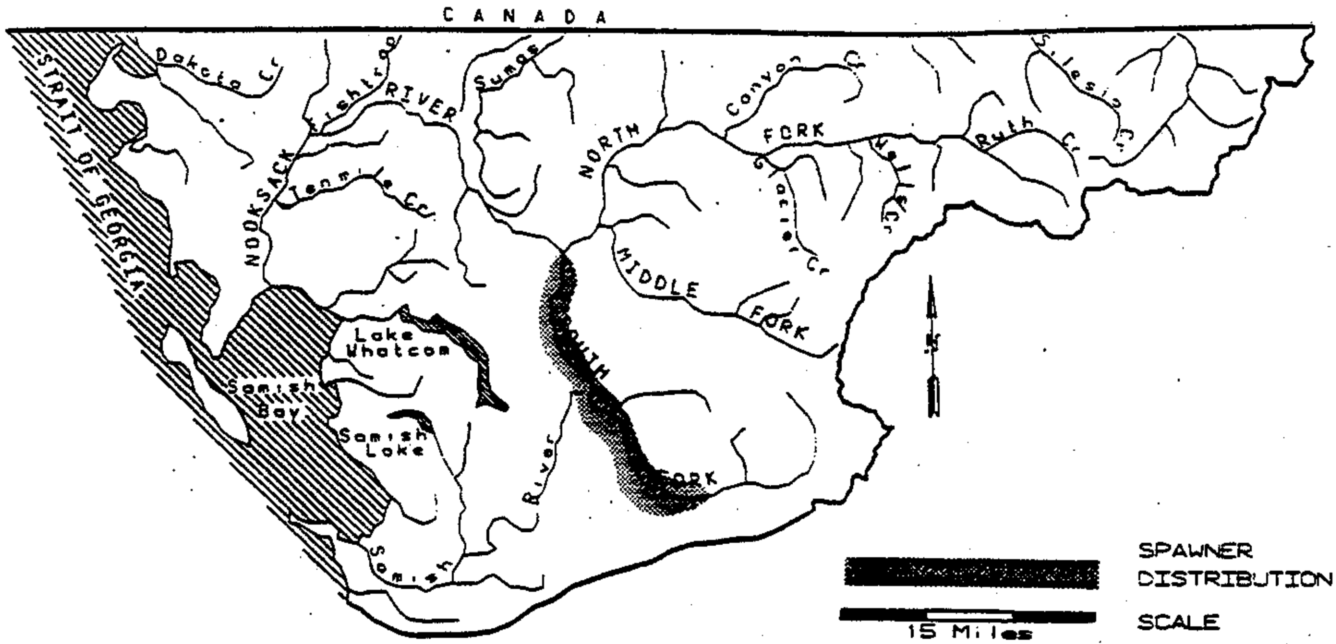
The status of the stock is Unknown.

The estimated total number of pink salmon returning to the entire Nooksack basin pink salmon has ranged from 39,000 to 320,000 over the last ten cycles with escapement estimates ranging from 15,000 to 136,000. Production from the South Fork is included in these figures. The actual contribution is unknown but is believed to be small. Estimated total returns are calculated from escapement estimates and harvest data, and include Canadian interceptions. Escapement estimates are based on a comparison of spawning ground counts in designated index areas to counts for the same areas made during 1959, 1961, and 1963 when escapements were determined by tagging studies. Hutchinson Creek is the only index stream in the South Fork drainage. It has suffered recent habitat degradation and may not represent the South Fork as a whole. No other areas on the South Fork are surveyed for pink salmon on a regular basis.

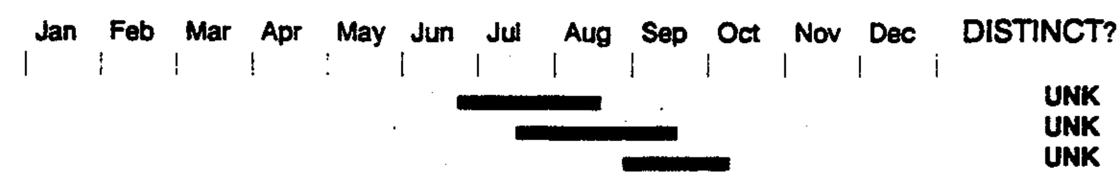
Hatchery operational impacts have not been determined. There is no enhancement of this stock.

STOCK DEFINITION PROFILE for South Fork Nooksack Pink

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

GENETICS - No GSI data for this specific stock. (See: North/Middle Fork Nooksack River stock).

STOCK STATUS PROFILE for South Fork Nooksack Pink

STOCK ASSESSMENT

DATA QUALITY-----> Unknown

Return Years	NO DATA			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				

Odd-year returns only.

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

OVERVIEW -- NOOKSACK SUMMER AND WINTER STEELHEAD STOCKS

SUMMER:	WINTER:
SOUTH FORK NOOKSACK	DAKOTA CREEK
	MAINSTEM / NORTH FORK NOOKSACK
	SOUTH FORK NOOKSACK
	MIDDLE FORK NOOKSACK

STOCK DEFINITION AND ORIGIN

In the Nooksack River system, one summer steelhead stock and three winter steelhead stocks have been identified. Wild summer steelhead in the South Fork Nooksack River and wild winter steelhead in Mainstem/North Fork Nooksack River, Middle Fork Nooksack River, and South Fork Nooksack River are distinct stocks. Dakota Creek is an independent drainage flowing into Drayton Harbor near Blaine, but is included in this overview. Wild winter steelhead in Dakota Creek are a distinct stock. All steelhead, summer and winter, in this basin are native.

There is little or no information available to indicate that these are genetically distinct stocks. The stocks are treated separately due to the geographical isolation of the spawning populations. There may be more or fewer stocks identified once comprehensive genetic information is available.

Run-timing of the summer steelhead stock is distinct from run-timing of the winter steelhead stocks in the Nooksack River system.

The native summer stock was historically a small run of fish limited by its habitat. These fish developed in areas isolated from the native winter stocks. In the Nooksack River system this occurs upstream of falls that were probable migration barriers except during the low flows of summer and fall. Since only a few miles of stream were used, the summer steelhead population was small.

While about 110,000 hatchery winter steelhead smolts are planted in the Nooksack River system annually, there is little contribution to the wild stock from hatchery fish spawning in the wild. The returning hatchery adults support tribal and sport fisheries with a high exploitation rate. Given the difference in spawn-timing between the hatchery fish (January and February) and the wild fish (mid-February through May), the potential for interbreeding is limited.

No hatchery summer steelhead smolts are stocked in the Nooksack River system.

STOCK STATUS

Wild winter steelhead spawner escapement has been monitored in index tributaries of the Nooksack River system since the 1983-84 season. Wild escapement is exhibiting a short-term decline, but each winter steelhead stock is rated as Unknown (see Stock Reports), primarily due to a lack of mainstem spawning information as a result of poor water clarity and visibility.

The wild winter steelhead run in the Nooksack River system is fished upon by the Nooksack Tribe and Lummi Tribe in the lower mainstem Nooksack and in nearby marine waters (Bellingham Bay and Union Bay). Sport anglers fish in the mainstem of the Nooksack River and forks. The targeted tribal fishery occurs primarily during December and January while the sport fishery occurs from November through March on the mainstems. Wild winter steelhead have been protected from sport harvest in freshwater areas since 1984 and in all marine areas since 1993.

Wild summer steelhead spawning escapement is not monitored and escapement goals have not been identified. There are no tribal fisheries that target Nooksack River system summer steelhead, but they may be caught incidentally in other tribal salmon and steelhead fisheries. These stocks have been managed with regulations to protect wild adults from sport harvest in freshwater areas since 1983 and in all marine areas since 1993, but some hook-and-release mortality of wild steelhead may occur. Because of the small population sizes and limited habitats used, the wild summer steelhead stock will always be fragile.

More information on each stock is presented in separate Stock Reports.

NOOKSACK/SAMISH -- SOUTH FORK NOOKSACK SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in the South Fork Nooksack River are native and a distinct stock based on the geographical isolation of the spawning population. This is the only summer steelhead stock in the Nooksack River system.

Little is known about the genetic composition of the stock. Although run-timing and specific spawn-timing are unknown, if similar to other wild summer steelhead stocks in the Puget Sound area, run-timing is generally from May through October and spawn-timing is generally from February through April.

STOCK STATUS

This stock is comprised of a historically small number of steelhead (probably < 200 adults), but stock status is Unknown. Spawning escapement is not monitored for this stock nor has an escapement goal been identified. Sport harvest data are not available since wild summer steelhead have been protected from harvest since 1983.

FACTORS AFFECTING PRODUCTION

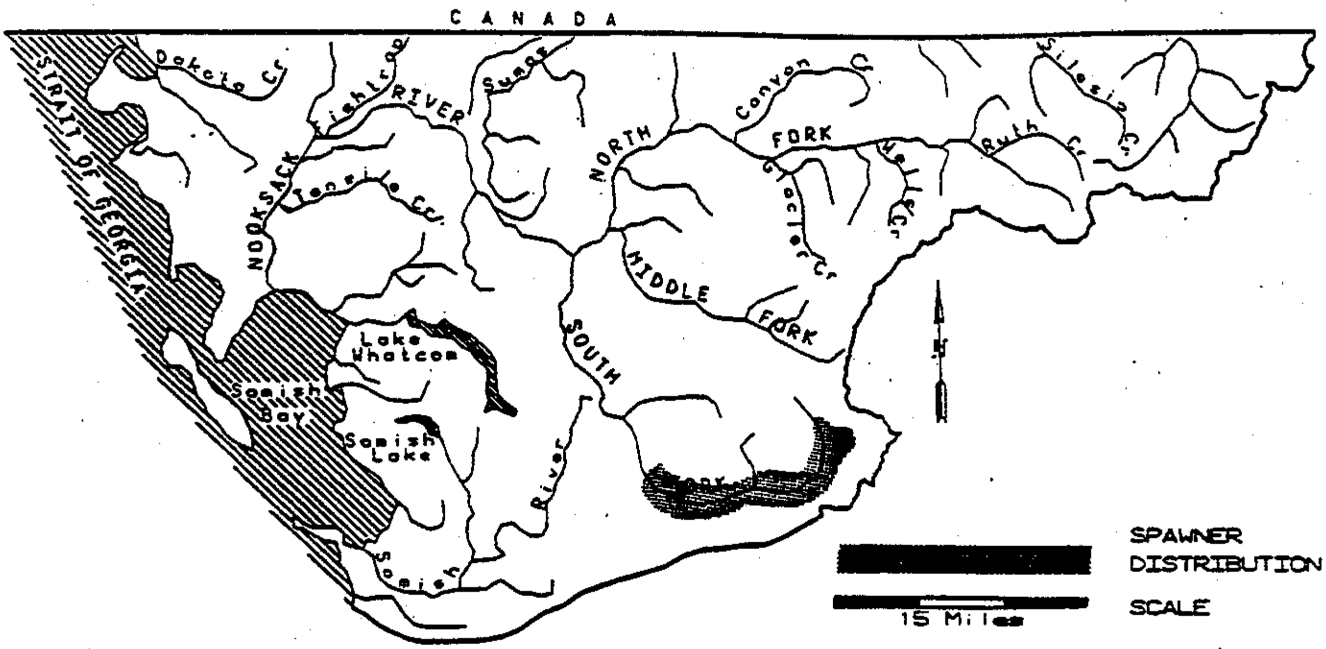
Habitat -- The stock is likely depressed due to flooding and habitat instability.

Harvest Management -- There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. Wild summer steelhead have been protected from sport harvest since 1983 by special regulations, but some hook-and-release mortality may occur.

Hatchery -- Hatchery summer steelhead smolts have not been stocked.

STOCK DEFINITION PROFILE for SF Nooksack Summer Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													UNK
SPAWNING													UNK

BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for SF Nooksack Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY-----> Poor

Return Years	NO DATA			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

NOOKSACK/SAMISH -- DAKOTA CREEK WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in Dakota Creek, its forks and tributaries are native and a distinct stock based on the geographical isolation of the spawning population. Dakota Creek is an independent drainage flowing into Drayton Harbor near Blaine.

Little is known about the genetic composition of the stock.

Run-timing is generally from early November through March. Specific spawn-timing is unknown, but is believed to be similar to other wild winter steelhead stocks in the Puget Sound area (mid-February to early June).

STOCK STATUS

This stock is comprised of a historically small number of steelhead, but stock status is Unknown.

Spawning escapement is not monitored for this stock nor has an escapement goal been identified.

Sport harvest is available for many years, but wild summer steelhead were not reported separately on steelhead permit cards until the 1986-87 winter steelhead season. Sport harvest of wild winter steelhead is available for only the early portion of the run because the sport steelhead season closes on February 28. As a result, sport harvest cannot be used to assess the status of the wild stock.

FACTORS AFFECTING PRODUCTION

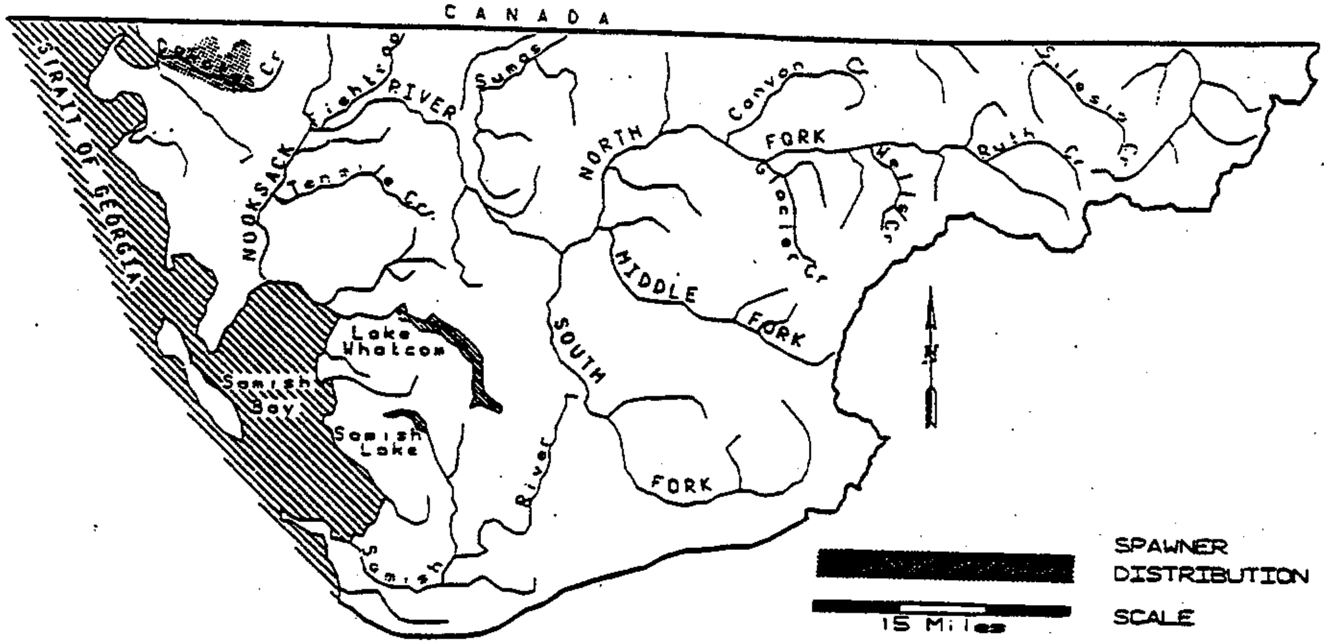
Habitat -- No surveys of habitat condition have been conducted.

Harvest Management -- There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. The sport fishery closes before the majority of the wild stock enters the stream.

Hatchery -- Hatchery winter steelhead have not been stocked in Dakota Creek.

STOCK DEFINITION PROFILE for Dakota Cr Winter Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY	■	■	■								■	■	NO
SPAWNING													UNK

BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Dakota Cr Winter Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Fair

Return Years	HARVEST Sport			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87	14			
88	6			
89	15			
90	4			
91	4			
92	2			

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

NOOKSACK/SAMISH -- MAINSTEM / NORTH FORK NOOKSACK WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the mainstem Nooksack River, North Fork Nooksack River, and tributaries are native and a distinct stock based on the geographical isolation of the spawning population.

Little is known about the genetic composition of the stock.

Run-timing is generally from December through April and spawn-timing is from early March through May.

STOCK STATUS

The status of the stock is Unknown but appears to be Depressed.

The number of adults spawning in the mainstem is unknown due to visibility problems. Wild steelhead spawner escapement has been surveyed in index areas in six North Fork tributaries since 1984. Two of the lowest wild steelhead spawner escapements have been recorded during the last five years. Redd density averaged 0.022 redds/lineal meter (35 redds/mile) during 1984 to 1989 and averaged 0.011 redds/lineal meter (18 redds/mile) during 1990 to 1992, a 50% decline in the last three years. It is uncertain, however, whether redd density in index areas is representative of spawner escapement for the stock.

FACTORS AFFECTING PRODUCTION

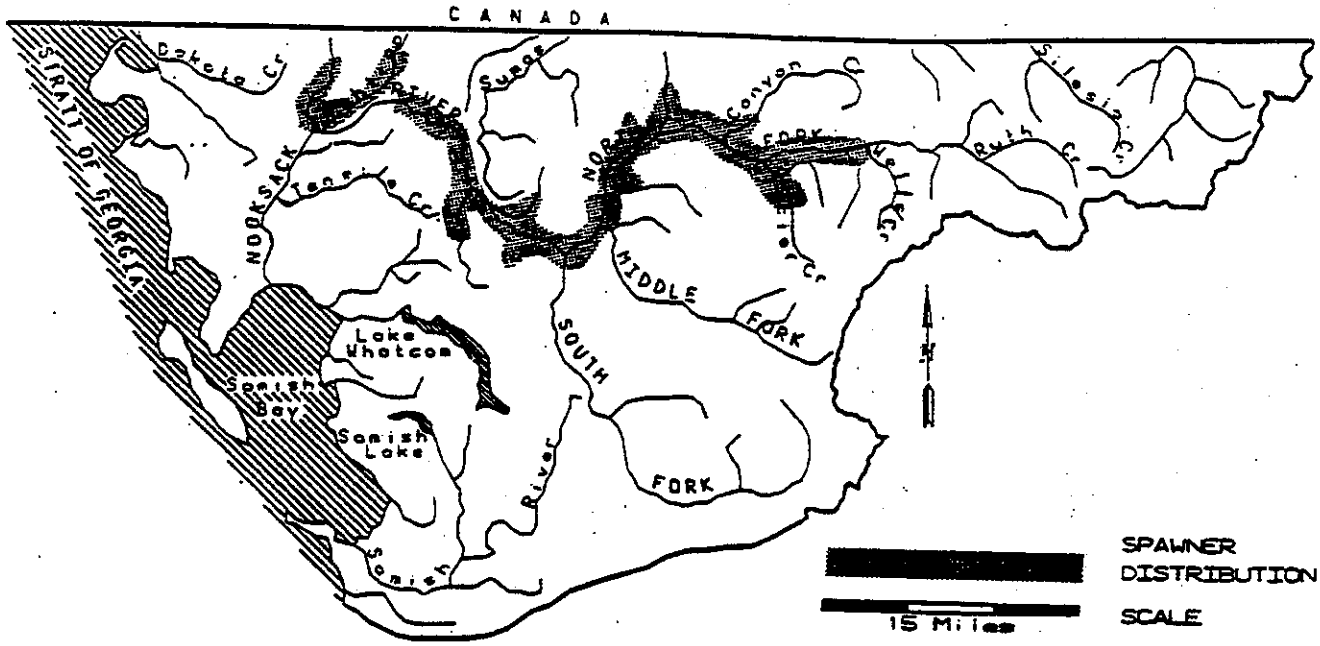
Habitat -- The stock is likely depressed due to flooding and habitat instability. The short-term decline for this stock is primarily due to recent changes in ocean survival. The reduction in returning steelhead adults to this system could result in a relatively long recovery period.

Harvest Management -- There is no directed tribal fishery on this wild stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. The sport fishery closes on March 31 and wild winter steelhead have been protected from sport harvest since 1984 by special regulations, but some hook-and-release mortality may occur.

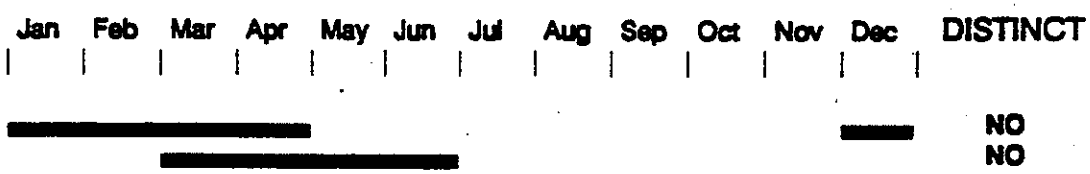
Hatchery -- While hatchery winter steelhead smolts have been stocked, there is little contribution to the wild stock from hatchery fish spawning in the wild.

STOCK DEFINITION PROFILE for Mainstem/NF Nooksack Winter Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING



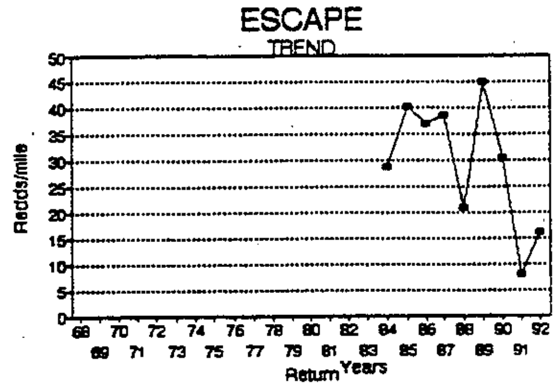
BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Mainstem/NF Nooksack Winter Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Redds/mile			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84	28.9			
85	40.2			
86	37.0			
87	38.6			
88	20.9			
89	45.1			
90	30.6			
91	8.1			
92	16.1			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

NOOKSACK/SAMISH -- SOUTH FORK NOOKSACK WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the South Fork Nooksack River are native and a distinct stock based on the geographical isolation of the spawning population.

Little is known about the genetic composition of the stock.

Run-timing is generally from December through May and spawn-timing is generally from mid-February to mid-June for wild winter steelhead in this stock.

STOCK STATUS

The status of the stock is Unknown, but appears to be Depressed.

The number of adults spawning in the mainstem is unknown due to visibility problems. Stock status is based upon wild steelhead spawner escapement in index areas in four South Fork tributaries surveyed since 1984. Two of the lowest wild steelhead spawner escapements have been recorded during the last five years. Redd density averaged 0.016 redds/lineal meter (26 redds/mile) during 1984 to 1989 and averaged 0.011 redds/lineal meter (18 redds/mile) during 1990 to 1992, a 31% decline in the last three years. It is uncertain, however, whether redd density in index areas is representative of spawner escapement for the stock.

FACTORS AFFECTING PRODUCTION

Habitat -- The stock is likely depressed due to flooding and habitat instability. The reduction in returning steelhead adults to this system could result in a relatively long recovery period.

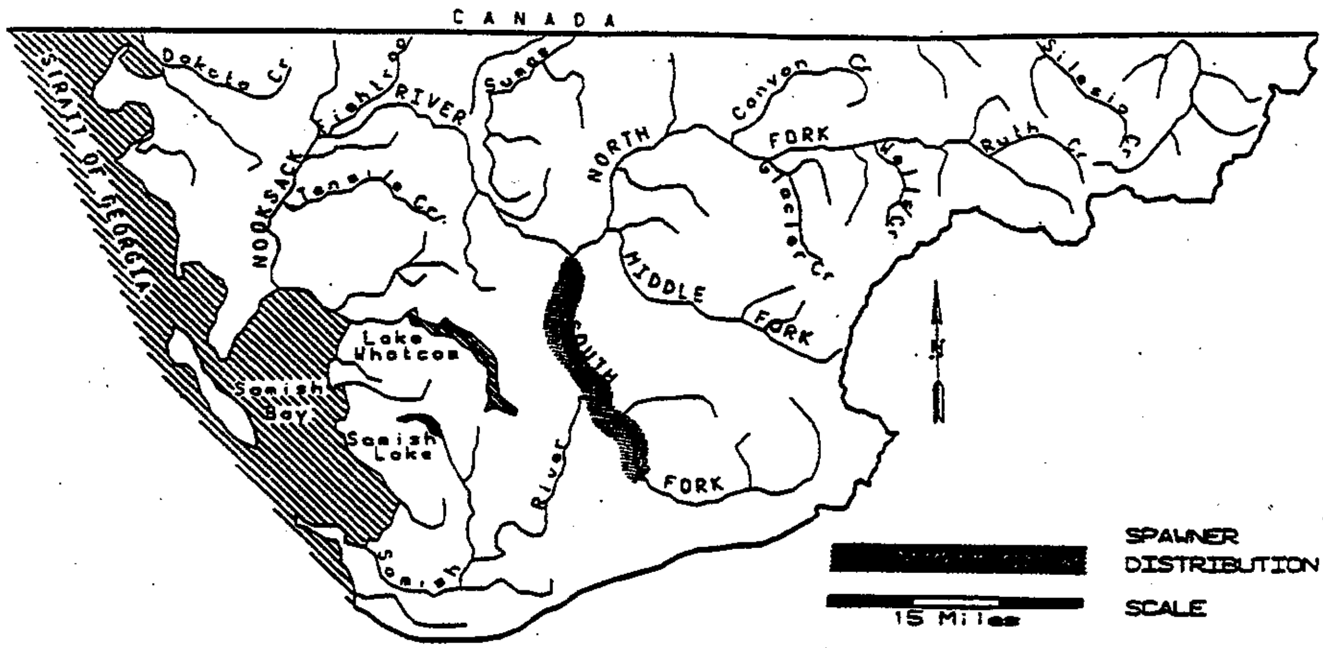
Harvest Management -- There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. The sport fishery closes before the majority of the wild stock enters the stream. Winter steelhead have been protected from sport harvest since 1984 by special regulations, but some hook-and-release mortality may occur.

Hatchery -- While hatchery winter steelhead smolts have been stocked, there is little contribution to the wild stock from hatchery fish spawning in the wild.

STOCK DEFINITION PROFILE for SF Nooksack Winter Steelhead

SPAWNER DISTRIBUTION

DISTINCT? - YES



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													NO
SPAWNING													NO

BIOLOGICAL CHARACTERISTICS

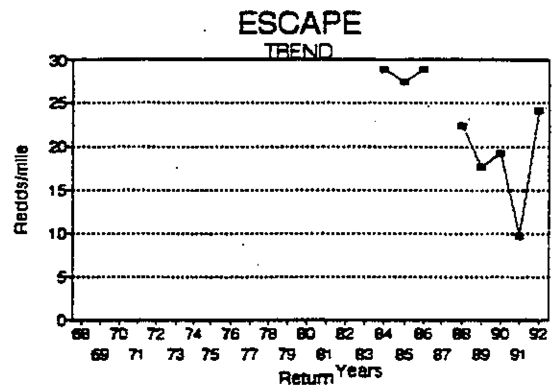
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for SF Nooksack Winter Steelhead

STOCK ASSESSMENT

DATA QUALITY——> Good

Return Years	ESCAPE Redds/mile			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84	28.9			
85	27.4			
86	28.9			
87				
88	22.5			
89	17.7			
90	19.3			
91	9.7			
92	24.1			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

NOOKSACK/SAMISH -- MIDDLE FORK NOOKSACK WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the Middle Fork Nooksack River and tributaries are native and a distinct stock based on river entry timing and the geographical isolation of the spawning population. Little is known about the genetic composition of the stock.

Run-timing is distinct (November through December) and spawn-timing is from early March to May for wild winter steelhead in this stock.

This stock could have originally been destined to migrate and spawn upstream of the falls where the current Middle Fork dam (constructed in the late 1950s) is located. The mainstem group of this stock (as opposed to those in Middle Fork tributaries) may be remnants of summer steelhead.

STOCK STATUS

The status of the stock is Unknown but appears to be Depressed.

The number of adults spawning in the mainstem is unknown due to visibility problems. Stock status is based upon wild steelhead spawner escapement in index areas in two Middle Fork tributaries surveyed since 1984. Two of the lowest wild steelhead spawner escapements have been recorded during the last five years. Redd density averaged 0.025 redds/lineal meter (40 redds/mile) during 1984 to 1989 and averaged 0.011 redds/lineal meter (18 redds/mile) during 1990 to 1992, a 44% decline in the last three years. It is uncertain, however, whether redd density in index areas is representative of spawner escapement for the stock.

FACTORS AFFECTING PRODUCTION

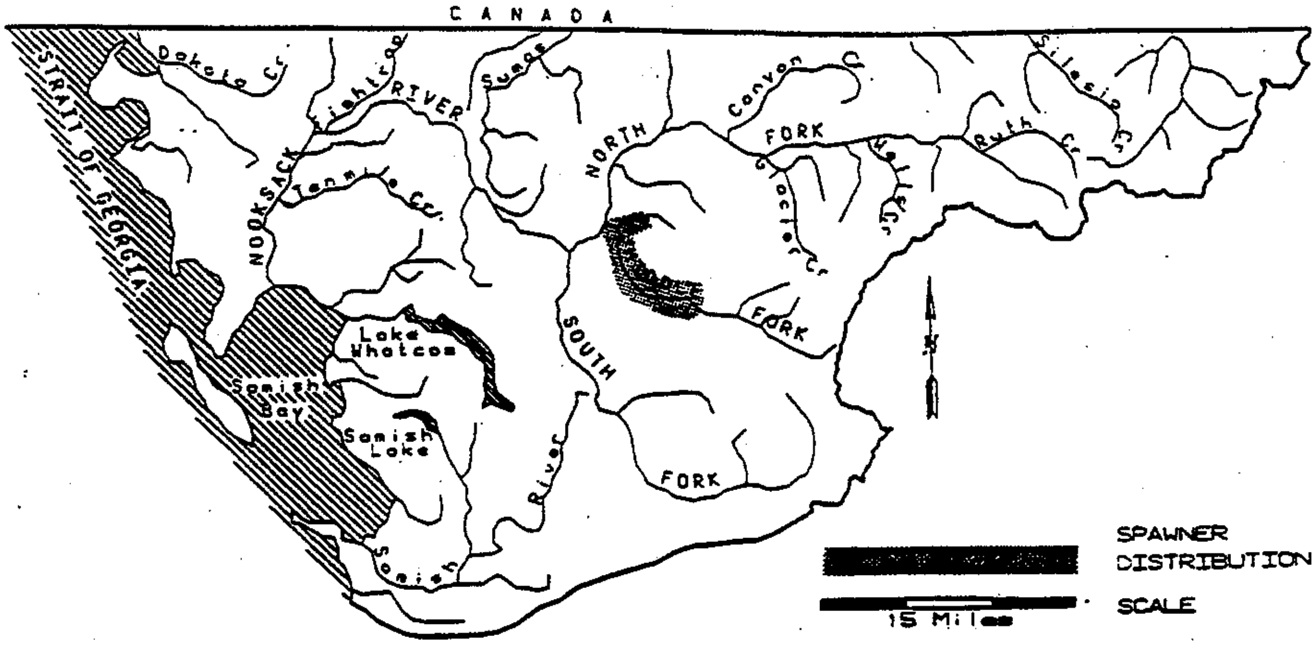
Habitat -- The stock is likely depressed due to flooding and habitat instability. The reduction in returning steelhead adults to this system could result in a relatively long recovery period.

Harvest Management -- There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. The sport fishery closes before the majority of the wild stock enters the stream. Winter steelhead have been protected from sport harvest since 1984 by special regulations, but some hook-and-release mortality may occur.

Hatchery -- While hatchery winter steelhead smolts have been stocked, there is little contribution to the wild stock from hatchery fish spawning in the wild.

STOCK DEFINITION PROFILE for MF Nooksack Winter Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													YES
SPAWNING													NO

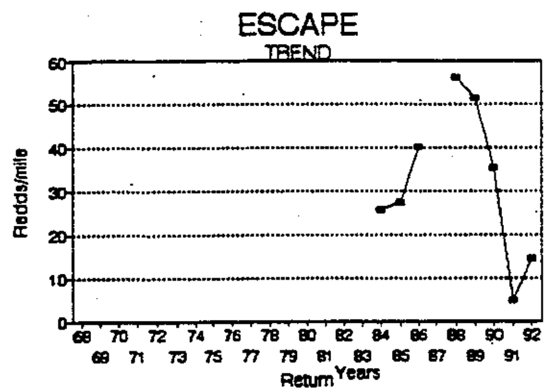
BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for MF Nooksack Winter Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Redds/mile			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84	25.8			
85	27.4			
86	40.2			
87				
88	56.3			
89	51.5			
90	35.4			
91	4.8			
92	14.5			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Spawning Distribution

STOCK STATUS

Unknown

SCREENING CRITERIA

OVERVIEW -- SAMISH SUMMER AND WINTER STEELHEAD STOCKS

WINTER:
SAMISH

STOCK DEFINITION AND ORIGIN

In the Samish River, no summer steelhead stocks and one winter steelhead stock have been identified. Wild winter steelhead in the Samish River are native.

There is little or no information available to indicate that this is a genetically distinct stock. The stock is treated separately due to the geographical isolation of the spawning population. There may be more or fewer stocks identified once comprehensive genetic information is available.

While about 35,000 hatchery winter steelhead smolts are planted in the Samish River system annually, there is little contribution to the wild stock from hatchery fish spawning in the wild. Given the high exploitation rate of the hatchery fish in the sport and tribal fisheries combined and the difference in spawn-timing between the hatchery fish (January and February) and the wild fish (mid-February through May), the potential for interbreeding is limited.

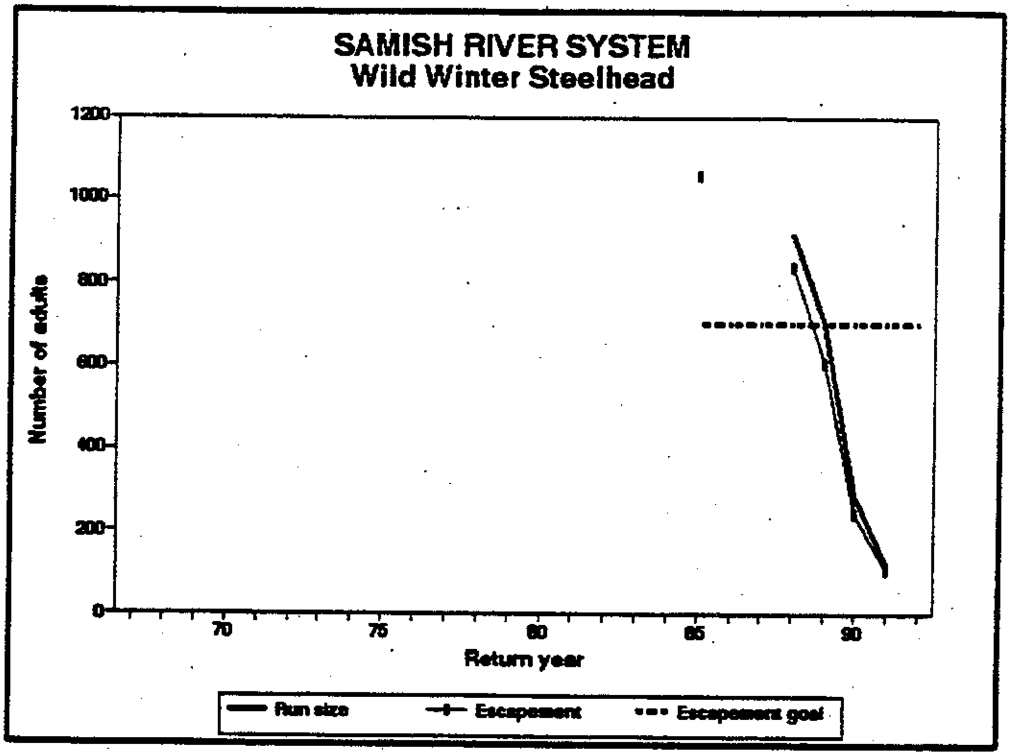
No summer steelhead smolts are stocked in the Samish River.

STOCK STATUS

Wild winter steelhead spawner escapement and run-size have been monitored periodically for the Samish River since the 1984-85 season. Wild escapement has ranged from 106 to 1,058 fish and wild run-size has ranged from 121 to 914 fish (see figure and table).

Beginning with the 1984-85 season, an escapement goal of 700 winter steelhead was set for the Samish River system and the fisheries were managed to achieve the goal. This goal is to be achieved by wild adults and does not include hatchery fish spawning in the wild. Since the escapement goal was set, wild escapement has averaged 570 fish and exceeded the goal during two of the five seasons it was measured (see figure and table).

More information on this stock is presented in a separate Stock Report.



Samish River system wild winter steelhead sport harvest, tribal harvest, spawner escapement, and run-size from 1984-85 through 1991-92.

Return year	Sport harvest	Tribal harvest	Spawner escapement	Run-size
1984-85			1,058	
1985-86				
1986-87	168			
1987-88	78		836	914
1988-89	95		606	701
1989-90	43		244	287
1990-91	15		106	121
1991-92	38			
Mean run-size distribution, 1987-88 to 1990-91.				
	58		448	506
	11.4%		88.6%	

NOOKSACK/SAMISH -- SAMISH WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the Samish River, Friday Creek, and tributaries are native and are a distinct stock based on the geographical isolation of the spawning population.

Little is known about the genetic composition of the stock.

Run-timing (November through March) and spawn-timing (February through May) are similar to other wild winter steelhead stocks in the Puget Sound region that are low elevation, direct saltwater entry, small streams.

STOCK STATUS

The status of the stock is Depressed.

The stock is exhibiting a short-term severe decline in wild steelhead spawner escapement and sport harvest of wild steelhead. Spawner escapement has ranged from 106 to 1,058 wild steelhead from 1985 to 1991. The spawner escapement goal is 700 wild steelhead.

A short-term decline in abundance is often difficult to distinguish from the normal fluctuation in abundance of all naturally produced stocks of fish. This stock has been rated as Depressed since it is important to attempt to identify declining stocks as early as possible.

FACTORS AFFECTING PRODUCTION

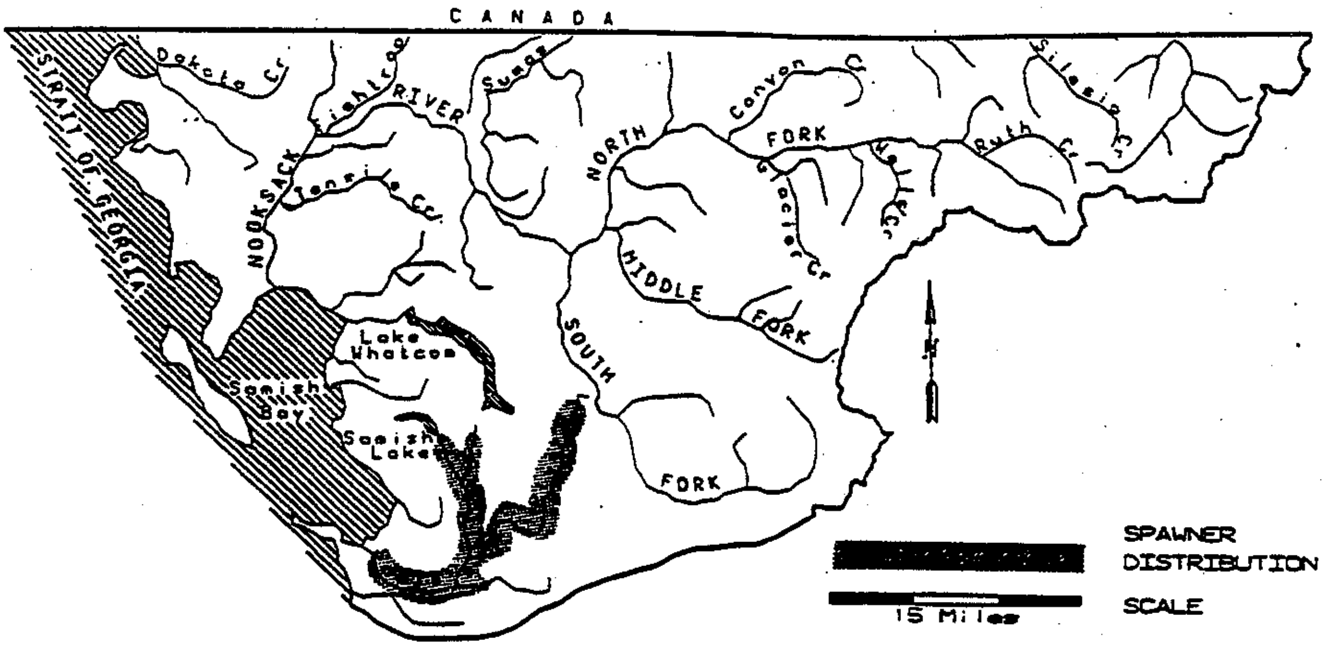
Habitat -- The stock is experiencing a short-term decline due to habitat destruction caused by severe flooding in the winters of 1983 and 1990 and by recent droughts in 1986, 1987, and 1992. Land use practices (diking, dredging, logging, and wetland filling) have contributed to the decline.

The short-term decline is also due to recent changes in ocean survival. A recent Washington Department of Wildlife study (Cooper and Johnson 1992) concluded that there have been long-term fluctuations and recent declines in winter, summer, hatchery and wild steelhead abundance and survival in the Puget Sound, Strait of Juan de Fuca, Pacific coast, and Columbia River areas in Washington. There were also similarities in the overall trends and year-to-year trends of steelhead abundance in Washington, British Columbia and Oregon. Similarities in survival trends over widespread geographic areas indicate that common factor(s) to each of these areas are responsible for recent changes in steelhead survival. A combination of factors

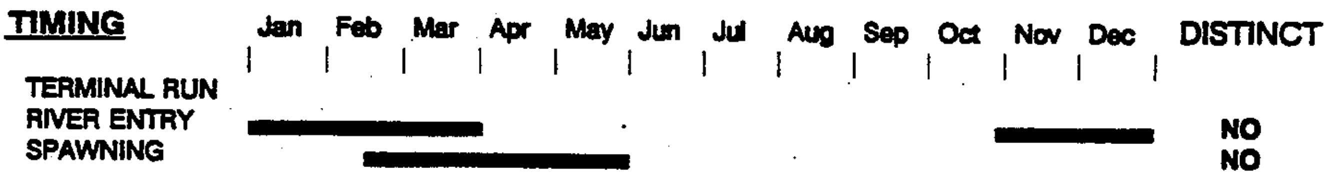
STOCK DEFINITION PROFILE for Samish Winter Steelhead

SPAWNER DISTRIBUTION

DISTINCT? - **YES**



TIMING



BIOLOGICAL CHARACTERISTICS

DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Samish Winter Steelhead

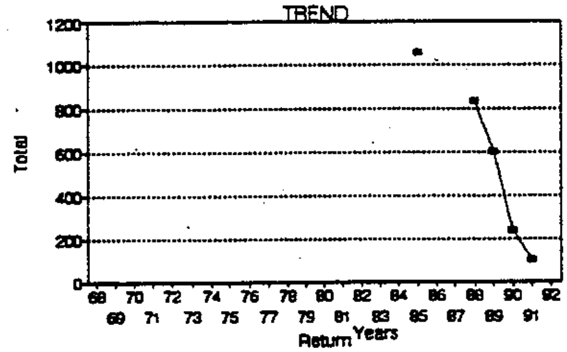
STOCK ASSESSMENT

DATA QUALITY-----> Fair

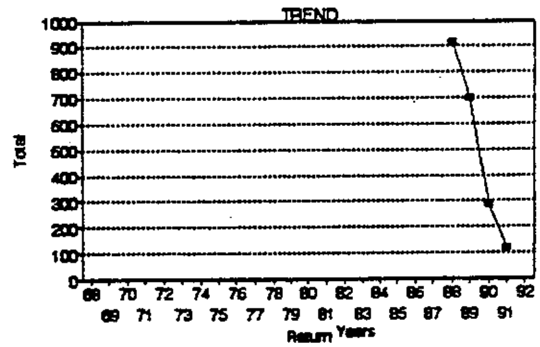
Return Years	ESCAPE Total	RUNSIZE Total	HARVEST Sport	
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85	1058			
86				
87			168	
88	836	914	78	
89	606	701	95	
90	244	287	43	
91	106	121	15	
92			38	

Escapement Goal=700

ESCAPE

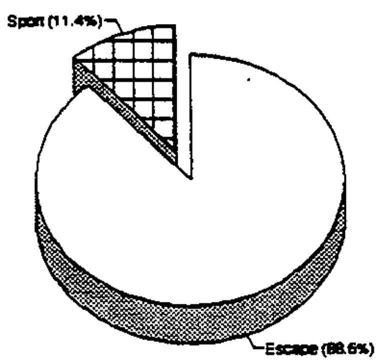


RUNSIZE



AVERAGE RUNSIZE DISTRIBUTION

YEARS 1988-1991



STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Depressed

SCREENING CRITERIA
Short Term Severe Decline

contributed to the recent decline in steelhead abundance including low ocean productivity, competition for food in the ocean, and catch of steelhead in authorized and unauthorized high seas drift net fisheries.

Harvest Management -- There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. This stock has been managed with wild steelhead release regulations to protect the wild stock from sport harvest in freshwater areas since 1986 and in all marine areas since 1993, but some hook-and-release mortality of wild steelhead may occur.

Hatchery -- While hatchery steelhead smolts have been stocked in this and nearby streams, there is little contribution to the wild stock from hatchery fish spawning in the wild.

OVERVIEW -- NORTH SOUND INDEPENDENTS COHO STOCKS

WHIDBEY ISLAND
ORCAS ISLAND

STOCK DEFINITION AND ORIGIN

We know very little about these two groups of fish. The existence of naturally-produced coho has been documented, but no systematic stock assessment data have been collected. Orcas Island and Whidbey Island coho were identified as stocks and grouped together as North Sound Independent coho solely on the basis of their geographical distribution. Non-local coho have been released in both areas, but the impact on these stocks is unknown, and the genetic relation between these stocks and other coho stocks in the region is not clear.

STOCK STATUS

No stock assessment data have been collected on these stocks, so their status is Unknown.

More information on each stock is presented in separate Stock Reports.

NORTH SOUND INDEPENDENT -- WHIDBEY ISLAND COHO

STOCK DEFINITION AND ORIGIN

This stock was designated on the basis of distinct geographic spawning distribution. From what we know, this stock enters the independent streams on southern Whidbey and does not display any unique spawning or run-timing or any distinct biological characteristics. This small stock is known to occur in Maxwelton Creek and possibly other drainages. Separation from other stocks is tentative pending additional information.

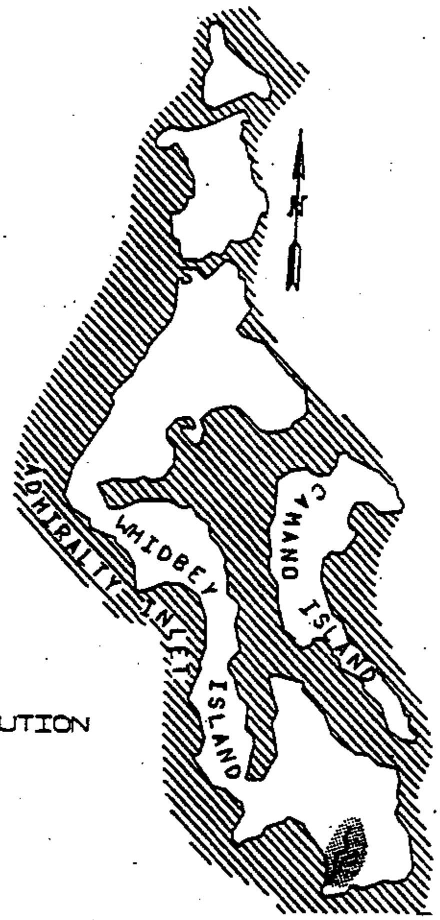
This stock is probably of mixed origin. Non-local coho (Skykomish) have been released into most of these streams. Also, an active non-local stock net pen project (Langley) and enhancement projects using non-local stocks have been probably recruited adults to these streams.

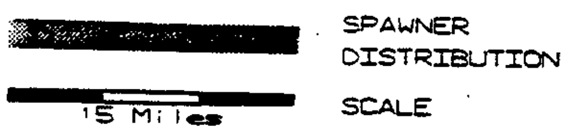
STOCK STATUS

Without any stock assessment data, escapement estimates are non-existent. Stock status is Unknown. The largest numbers appear to be in Maxwelton Creek based on sightings by enhancement project volunteers.

STOCK DEFINITION PROFILE for Whidbey Island Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**





TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY													**UNK**
SPAWNING													**UNK**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

STOCK STATUS PROFILE for Whidbey Island Coho

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	NO DATA			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Unknown

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawn Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

NORTH PUGET SOUND INDEPENDENT -- ORCAS ISLAND COHO

STOCK DEFINITION AND ORIGIN

This stock was designated on the basis of distinct geographic spawning distribution. This stock is not known to possess any unique temporal distribution or biological characteristics. This small population is known to occur in Cascade Creek (outlet of Cascade Lake) and possibly other drainages. Separation from other stocks is tentative pending additional information.

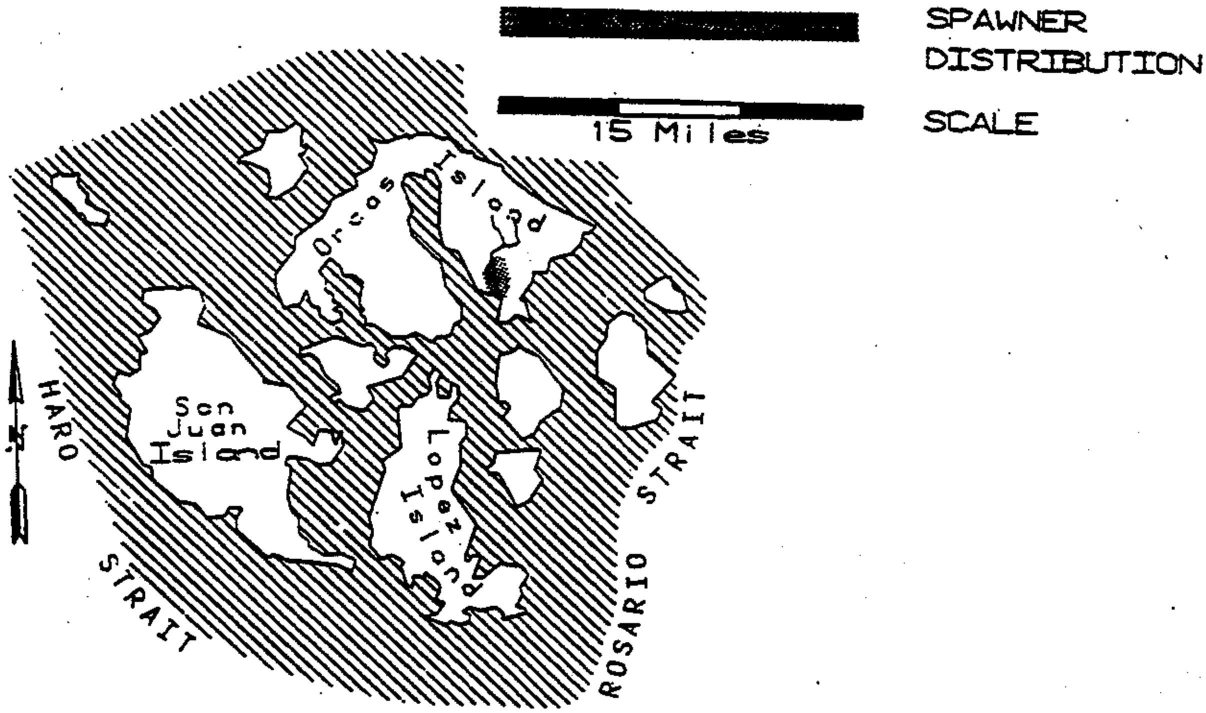
This stock is presumed to have been hybridized with non-local stocks (Nooksack and Samish) used in enhancement projects in the 1960s and released into Orcas Island streams.

STOCK STATUS

No stock assessment data exist, therefore escapement is unknown. Stock status is Unknown, however, the presence of zero-age coho have been documented annually by WDF biologists in July since 1985.

STOCK DEFINITION PROFILE for Orcas Island Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY													**UNK**
SPAWNING													**UNK**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **NO**

STOCK STATUS PROFILE for Orcas Island Coho

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	NO DATA			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Unknown

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawn Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

OVERVIEW -- SKAGIT CHINOOK STOCKS

UPPER SKAGIT MAINSTEM/TRIBS SUMMER
LOWER SKAGIT MAINSTEM/TRIBS FALL
LOWER SAUK SUMMER
UPPER SAUK SPRING
SUIATTLE SPRING
UPPER CASCADE SPRING

STOCK DEFINITION AND ORIGIN

The Skagit River supports what was historically the largest natural chinook run in Puget Sound. Skagit chinook spawn throughout the mainstem Skagit from the Gorge Dam down to Sedro Woolley, in the mainstem Sauk and Suiattle rivers and in the larger tributaries including Finney, Bacon, Day, Illabot, Goodell, Buck and Sulphur creeks. They prefer to spawn in larger streams. The habitat is affected by mainstem flow fluctuations resulting from mainstem dam operations, glacial siltation, and floods farther downstream. Skagit chinook generally migrate to saltwater during the summer and fall of their first year of life, although significant numbers overwinter in freshwater and outmigrate during their second spring. They mature and return to the river predominantly as three-, four- and five-year-olds, with most of them returning as four-year-olds.

Catch records prior to the initiation of hatchery planting in 1955, indicate that Skagit chinook entered the river from April to September, with three overlapping peaks in timing: a small spring (April-June) peak, a larger summer (July-August) peak, and a somewhat smaller fall (late August-September) peak (Orrell 1976). Although later hatchery plants have obscured the distinctness of these peaks, all three timing segments still remain in the Skagit.

For purposes of this inventory, the stock units have been defined primarily on the basis of genetic analyses of allele frequencies as well as consideration of spawn timing and distribution. The allele frequencies were significantly different among all of the samples except those taken from the upper Skagit and the upper Sauk, and between the upper Skagit and lower Skagit. These similarities suggest some population overlap. However, due to the differences observed among these three populations and all other Skagit populations, we tentatively decided to designate the lower Skagit, upper Skagit, lower Sauk, upper Sauk, Suiattle and upper Cascade as separate stock units. Samples for genetic composition have been collected but not analyzed from upper Cascade chinook, but, because this stock has a distinctly different spawning time and location from chinook in the lower Cascade, it was decided to designate the upper Cascade as a separate stock. Although the allele frequencies of the upper Skagit and upper Sauk samples were not significantly different, these were designated as separate stocks because they are geographically separated, and a separate stock, lower Sauk chinook, lies between them. While there may be exchange between upper Skagit and upper Sauk spawners, it seemed unlikely that this could happen without there also being significant exchange with lower Sauk spawners. Upper Skagit and lower Skagit were designated as separate stocks because of differences in run-timing and spawning timing.

STOCK STATUS

Terminal commercial catch records show a general decline in catches that has continued since at least the 1940s. Catches in the 1930s ranged between 30,000 - 50,000 per year, and there has been a decline every decade since then, until current commercial catches average less than 3,000 per year. Part of this decline is due to increasing Canadian interceptions. The great majority of the catch of Skagit basin spring chinook is taken in preterminal sport and commercial fisheries in Canada and Puget Sound (see following table). Part of the decline may also be due to decreases in production, but total production figures for Skagit chinook are lacking.

Distribution of adult equivalent fishing mortality for the Skagit basin spring chinook stocks.

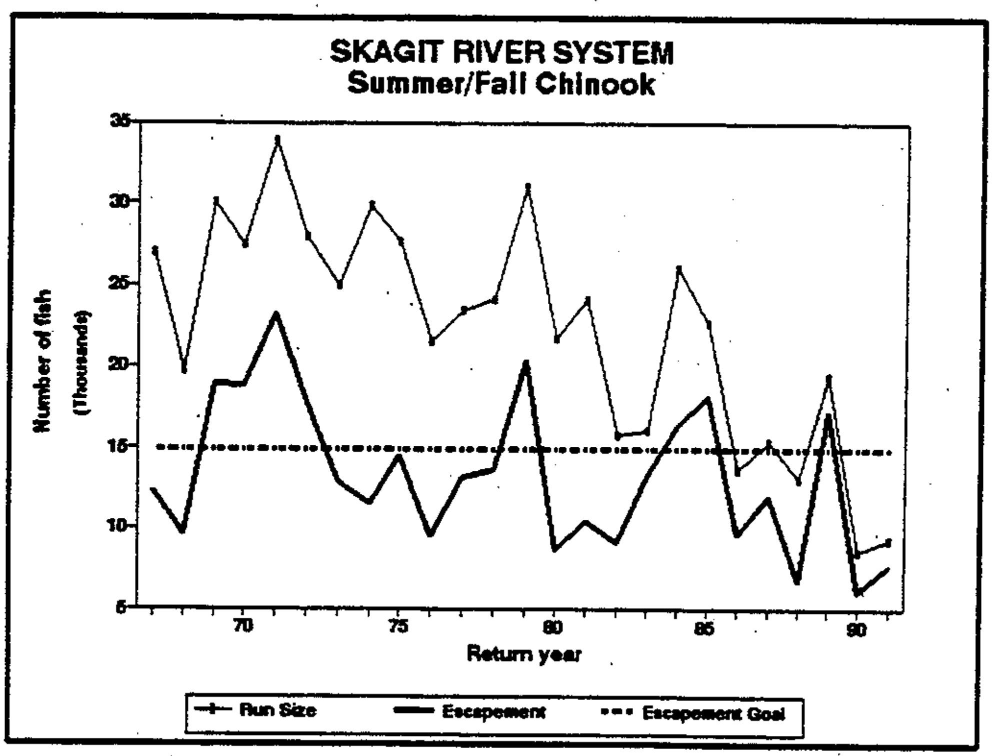
Brood	Alaska All	Canada All	PFMC Spt/Tr	Troll	Puget Sound North Net	Puget Sound Other Net	Sport
1981	4	69	0	0	11	11	6
1982	0	209	2	0	0	7	60
1983	0	40	0	0	10	4	14
1984	1	59	0	0	0	37	20
1985	0	373	0	40	69	233	156
1986[1]	0	180	4	10	19	32	55
1987[2]	0	169	7	9	0	78	110
Total 1981-86	5	930	6	50	109	324	291
Percent	0.3%	54.2%	0.3%	2.9%	6.4%	18.95	17.05

[1] Incomplete brood; ages 2 through 4 included in analysis.

[2] Incomplete brood; ages 2 and 3 included in analysis.

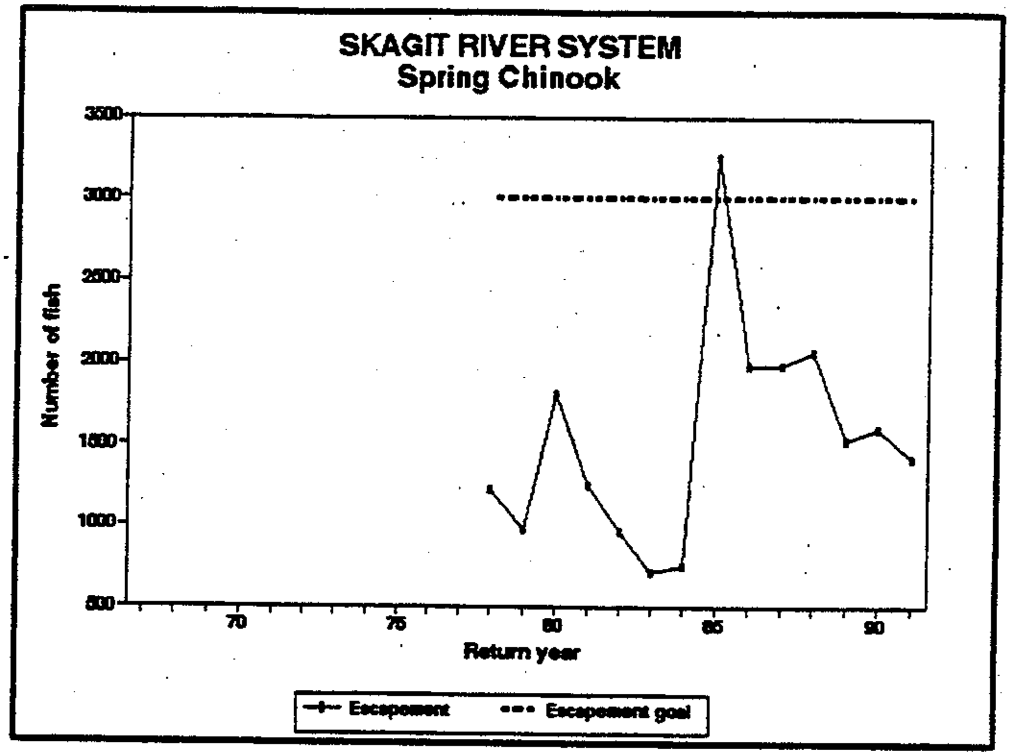
[3] North net includes the Strait of Juan de Fuca, Port Angeles, the San Juan Islands and the Blaine/Cherry Point areas (Puget Sound Salmon Stock Review Group, 1992).

The summer/fall chinook stocks are managed as an aggregate, but managed separately from the spring chinook stocks. Summer/fall escapement levels have been estimated since 1968. The run-size entering Puget Sound (which excludes hook-and-line catches) has decreased since the early 1980s, and has fallen below the escapement goal in three of the last five years. This decline is most apparent for lower Skagit and lower Sauk stocks. Recent overall escapement of summer/fall Skagit chinook is often below the escapement goal of 14,900 spawners/year. All Skagit chinook summer/fall stocks have generally lower escapements in odd years than in even years.



Spring chinook have an aggregate escapement goal of 3,000 spawners/year, and have only attained that goal once since 1968. Escapements have fluctuated widely, without a clear trend. Suiattle escapements have been declining, while upper Sauk escapements have remained stable. Upper Cascade spawner surveys have not been consistently conducted.

More information on each stock is presented in separate Stock Reports.



SKAGIT RIVER SYSTEM
Spring Chinook
Number of fish
Return year
Escapement
Escapement goal

SKAGIT -- UPPER SKAGIT MAINSTEM/TRIBS SUMMER CHINOOK

STOCK DEFINITION AND ORIGIN

Upper Skagit chinook are those that spawn in the mainstem Skagit and its tributaries above the Sauk River to Newhalem, excluding the upper Cascade River. This stock has been classified as unique based upon differences in genetic composition (1986), spawn timing, and geographical location. Genetic analyses have shown that upper Skagit chinook have statistically significant genetic differences from lower Sauk, Suiattle and Skagit hatchery summer or fall chinook. These analyses did not, however, show a significant difference between upper Skagit and upper Sauk chinook, or between upper Skagit summer and lower Skagit fall chinook (see profile).

Spawning occurs in September to early October and differs from the timing of the lower Skagit, upper Sauk, upper Cascade, and Suiattle chinook. Geographical distribution of spawners is in the mainstem Skagit and its larger tributaries upstream of the Sauk River.

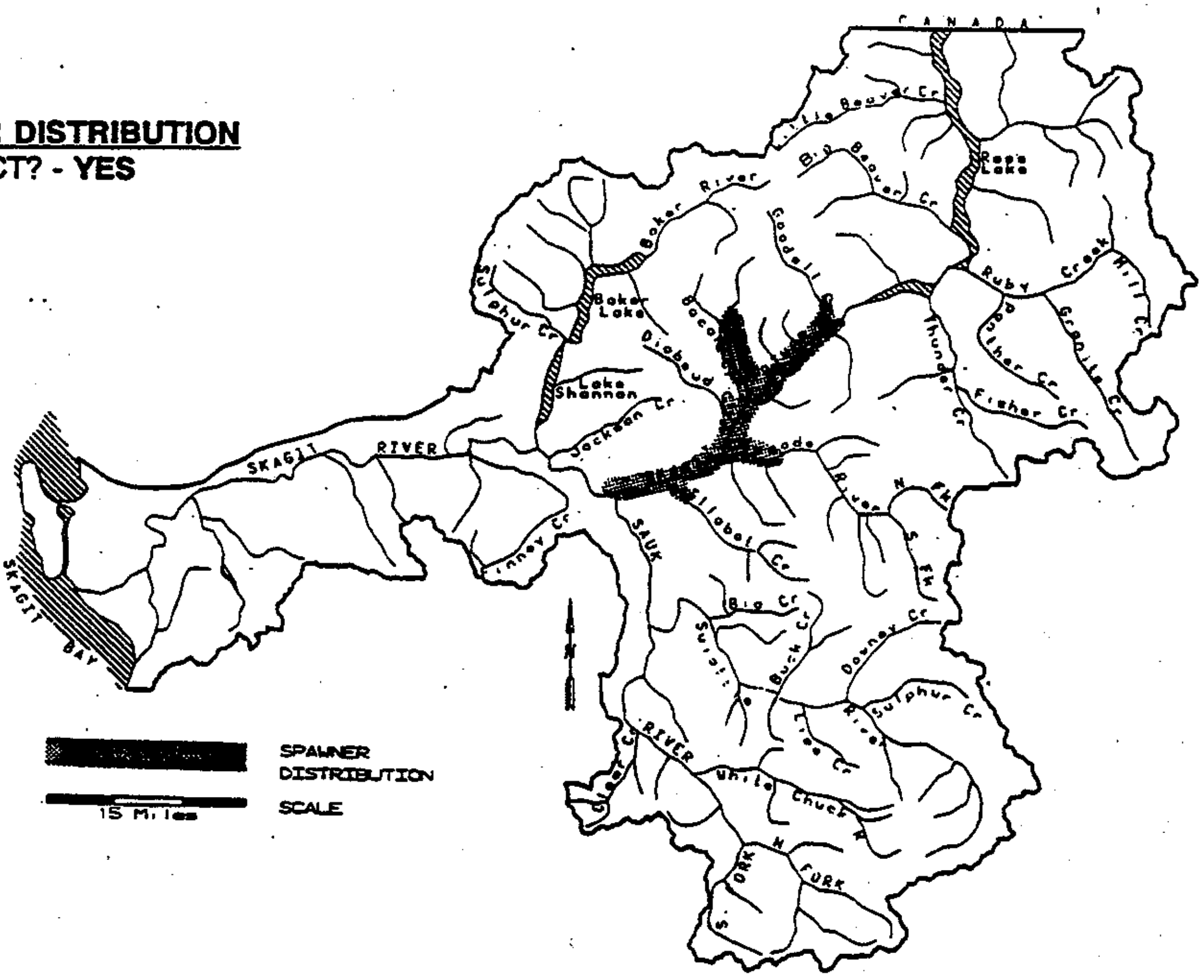
The stock origin is believed to be native. There is no hatchery production of this stock. This stock was the original source of the hatchery summer chinook stock; however, due to potential interbreeding with other stocks at the hatchery, the hatchery summer chinook stock now has significant genetic differences from this stock.

STOCK STATUS

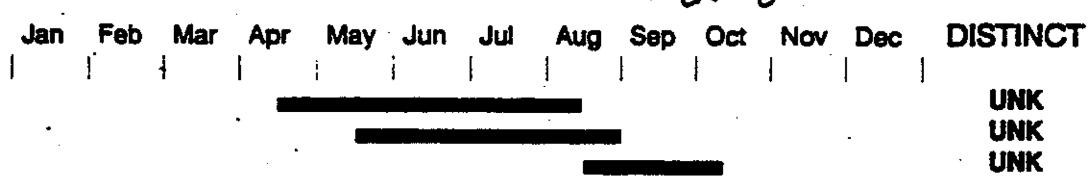
Data on total production, catches, and returns per spawner do not exist for this stock. The only production data that exist are spawning escapements. Based upon spawning escapements, this stock is currently classified as Healthy, although there is concern about recent lower levels in 1989 and 1991. In addition, the escapement levels in odd years have generally been lower than in even years. Escapement levels, excluding Illabot, Diobsud, Bacon, Falls, Goodell and Clark creeks, have averaged 7,945 fish/year with a range of 3,700-13,800 (1974-1991). Escapement in odd years have averaged 6,497 fish/year, while in even years has averaged 9,393 chinook per year. It is not known whether this odd-/even-year disparity is due to differences in production or to differences in catch levels between odd and even years. Escapement levels are based upon redd counts are considered very good measures of relative abundance from year to year.

STOCK DEFINITION PROFILE for Upper Skagit MS/Tribs Summer Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

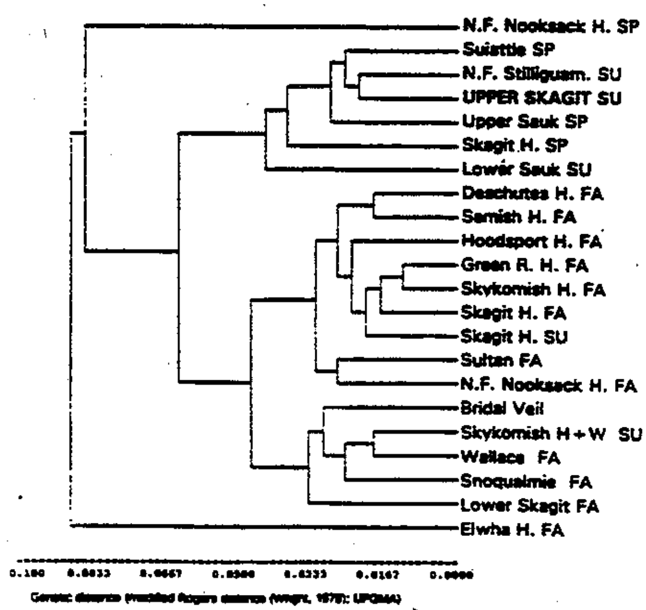


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **NO**

GENETICS - The genetic characteristics of a 1986 sample of Upper Skagit summer chinook were not significantly different ($p > .05$) from Lower Skagit fall chinook from 1986-87, or from Upper Sauk spring chinook from 1986. They were, however, different from Skagit hatchery stocks.

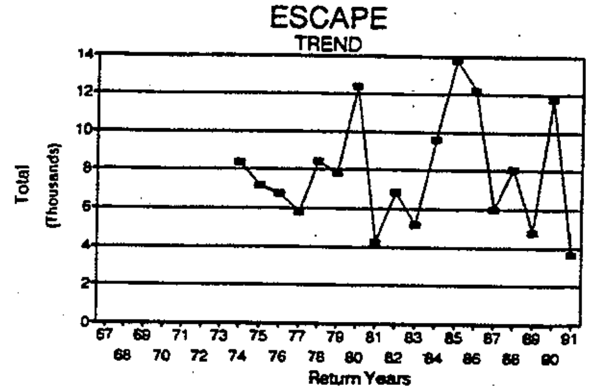


STOCK STATUS PROFILE for Upper Skagit MS/Tribs Summer Chinook

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total			
67				
68				
69				
70				
71				
72				
73				
74	8389			
75	7171			
76	6760			
77	5807			
78	8448			
79	7841			
80	12399			
81	4233			
82	6845			
83	5197			
84	9642			
85	13801			
86	12181			
87	5982			
88	8077			
89	4781			
90	11793			
91	3656			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution, Timing, Genetic

STOCK STATUS

Healthy

SCREENING CRITERIA

SKAGIT -- LOWER SKAGIT MAINSTEM/TRIBS FALL CHINOOK

STOCK DEFINITION AND ORIGIN

Lower Skagit chinook are those that spawn in the Skagit and its tributaries downstream of the Sauk River. Most of these fish spawn between Sedro Woolley and the Sauk River. This stock was defined as distinct, based upon differences in genetic composition, geographical distribution of redds, and spawning time. The lower Skagit chinook have statistically significant genetic differences from most other Puget Sound stocks examined, including other Skagit River components such as upper Sauk, lower Sauk, Suiattle, Skagit hatchery falls, and Skagit hatchery summers. They did not have significant genetic differences from the upper Skagit chinook. The chinook that spawn downstream of the mouth of the Sauk River are October spawners, a timing distinct from the earlier spawners that utilize the upper Skagit River, and they are believed to enter the river later than other Skagit chinook stocks.

The origin of this stock is native with no known significant hybridization with other Skagit stocks. Spawners from this stock may have been used at the Skagit Hatchery, but this stock is now genetically different from the Skagit hatchery fall stock.

STOCK STATUS

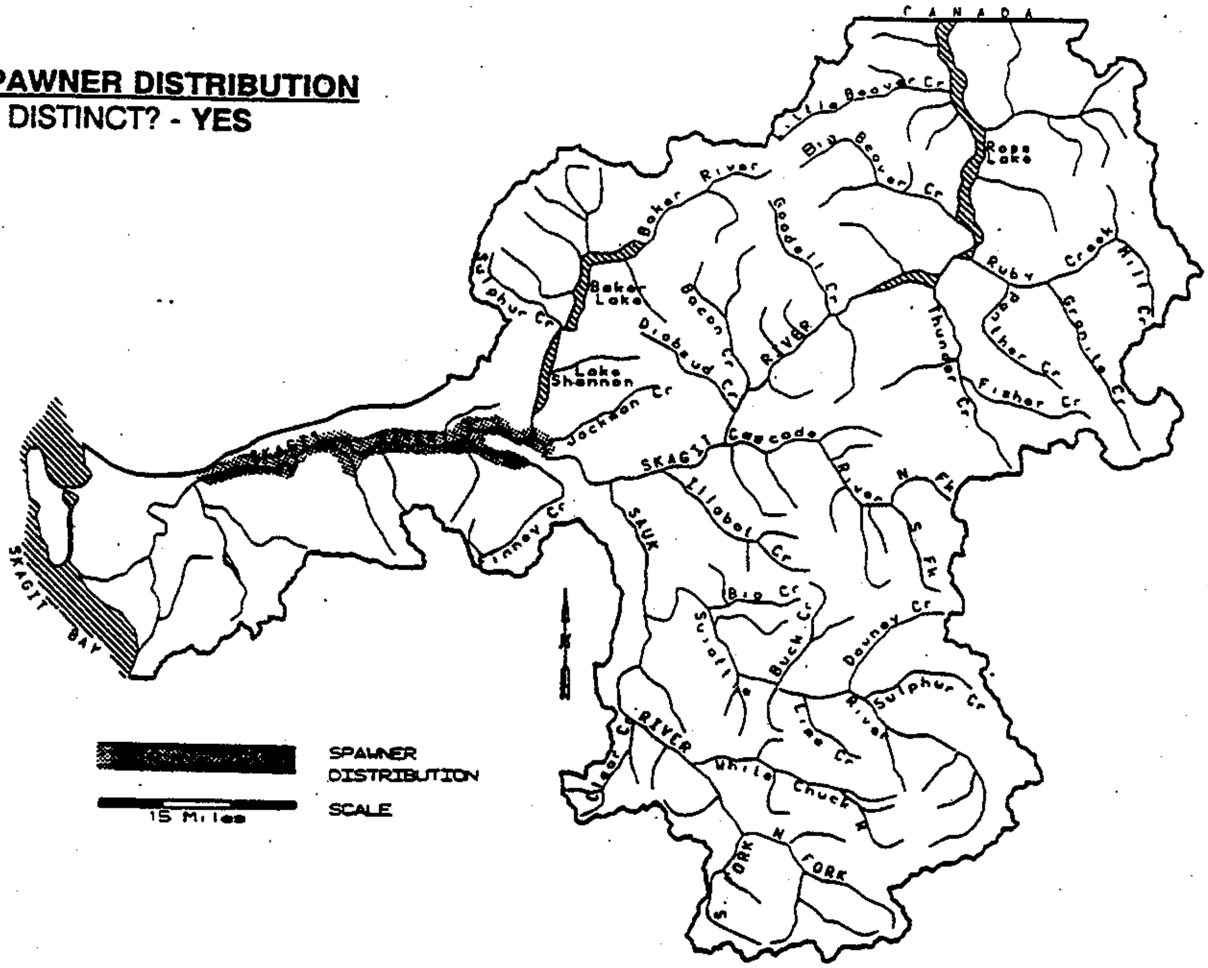
Data on total production, catches, and returns per spawner do not exist for this stock. The only production data that exist are spawning escapements. Based upon escapement levels, this stock is currently classified as Depressed due to a long-term negative trend and a short-term severe decline in escapements. Escapement estimates are based upon redd counts and are considered useful for comparative abundance from year to year. The average escapement, excluding tributaries, during the first five years (1974-1978) of the base period was 3,473. Levels declined to an average of 2,329 for the last five years (1987-1991) of the base period. Also, escapement levels have generally been lower in odd years than in even years, possibly due in part to the incidental catch of chinook in pink salmon fisheries, and possibly due to differences in production levels between odd and even years. While the average escapement was 2,987 from the years 1974-1991, the average escapement in odd years during that base period was 2,476 and the average in even years was 3,498.

FACTORS AFFECTING PRODUCTION

Habitat -- The most serious natural limiting habitat factor in this reach is glacial sedimentation of the streambed, primarily from glaciers in the Suiattle River watershed. Sedimentation has caused some spawners to avoid this area and has

STOCK DEFINITION PROFILE for Lower Skagit MS/Tribs Fall Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

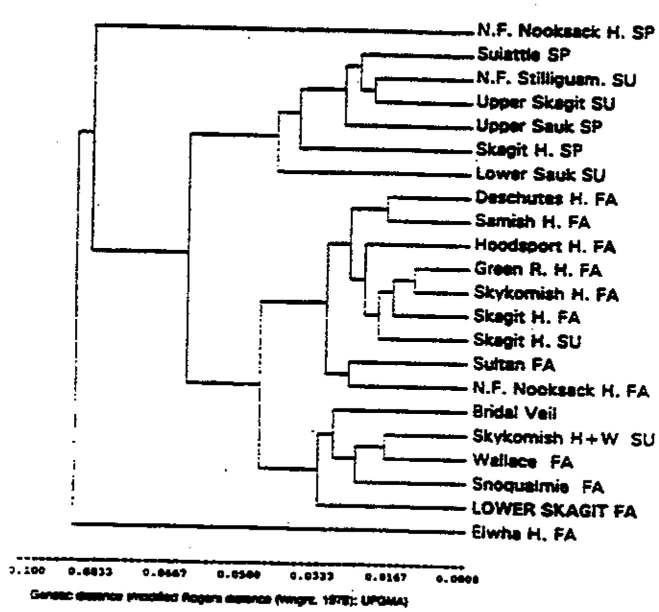


TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													UNK
RIVER ENTRY													UNK
SPAWNING													YES

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **NO**

GENETICS - The genetic characteristics of Lower Skagit fall chinook sampled in 1986-87 were not significantly different ($p > .05$) from those of Upper Skagit summer chinook from 1986. (This relationship is not revealed in the dendogram). Lower Skagit falls are genetically distinct from other Skagit wild stocks, and from the Skagit Hatchery stocks.

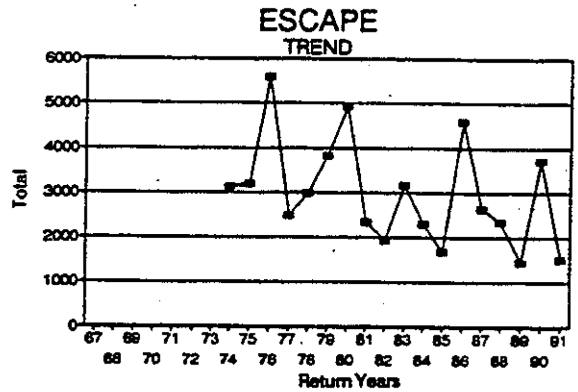


STOCK STATUS PROFILE for Lower Skagit MS/Tribs Fall Chinook

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total			
67				
68				
69				
70				
71				
72				
73				
74	3116			
75	3185			
76	5590			
77	2485			
78	2987			
79	3829			
80	4921			
81	2348			
82	1932			
83	3151			
84	2306			
85	1686			
86	4584			
87	2635			
88	2339			
89	1454			
90	3705			
91	1510			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution, Timing, Genetic

STOCK STATUS

Depressed

SCREENING CRITERIA

LT Neg Trend, ST Severe Decl'n

reduced incubation success. In addition, the Skagit mainstem and tributaries downstream of the Sauk were damaged by the 1982-1983 flood event, which blew out most tributaries and deposited loose, uncompacted gravel and sand in alluvial fans across lowland farm land. During the drought years of 1986-1987, most water in these areas went underground and stranded fish.

Impacts from logging occur in all parts of the upper watershed which contributes additional sedimentation to the mainstem. Lower river migration habitat is affected by agricultural diking, lack of large woody debris due to historic clearing and snag removal and loss of recruitment due to logging and conversion to agriculture or residential uses.

Historically, hydropower peaking has had drastic effects on fry in this river reach, especially in the area above the Baker River, but recent agreements with the power companies have reduced this threat. Estimated unavoidable losses will be mitigated by a combination of hatchery releases and habitat improvements.

Approximately 60% of estuarine areas have been lost through diking and draining, including nine distributary sloughs. Water quality in remaining estuarine areas is generally good in undiked areas.

Harvest Management -- In addition to being caught in preterminal fisheries in Alaska, Canada, the Strait of Juan de Fuca, and the San Juan Islands, these fish could also be caught in sport fisheries in Admiralty Inlet (Area 9), Possession Sound, Saratoga Pass and Skagit Bay (Area 8) and in chinook-and coho-directed net fisheries in the Skagit River and Skagit Bay, Port Gardner/Port Susan (Area 8A) and possibly the Seattle area (Area 10). Catch information on lower Skagit River fall chinook is not available.

Limited tribal commercial net fisheries directed at Skagit region-of-origin summer/fall chinook take place in Skagit Bay and the Skagit River. Since 1987 the average commercial catch during this fishery on all Skagit chinook stocks has been about 2,700 chinook. In addition, Skagit System Cooperative fisheries staff conduct a weekly six-hour test fishery in the Skagit River to collect information on run composition and timing.

Skagit summer/fall chinook are managed in terminal and extreme terminal areas for natural escapement and production.

Hatchery -- Hatchery impacts need further review. Data have not been compiled on effects of releases and straying. Chinook and coho yearlings are released into the Cascade River from the Skagit Hatchery located near Marblemount.

Last ten years salmon releases into the Skagit basin.

Release Year	Spring Chinook	Summer Chinook	Fall Chinook	Chum	Coho	Pink	Sockeye
1982	0	808768	2100322	0	3939462	650000	0
1983	9500	0	1697900	741500	2627520	0	0
1984	58600	634500	1650000	0	2649300	74400	0
1985	36000	951400	1082000	0	1894254	210000	0
1986	85762	408200	1116600	522500	585200	364100	0
1987	141212	209000	1772000	561900	292859	0	27966
1988	80800	404900	1443500	57200	495872	1033800	57300
1989	115200	692730	1274000	72000	440377	0	57060
1990	67400	695300	1439430	52600	272344	2800	45348
1991	419300	305120	1144500	115785	548698	0	113367
MEAN	112642	567769	1472025	303355	1374589	389183	60208

Other Factors -- Impacts of other species on lower Skagit fall chinook have not been studied. It is speculated that recent low marine survival rates may be related to increased abundances of mackerel, dogfish, or marine mammals. Poor ocean upwelling is believed to have reduced the available food for chinook; it is unknown what effect the increased abundance of Fraser sockeye may have had on this food supply. Effects of hatchery and natural production of other salmonids, as noted above, have not been examined.

SKAGIT -- LOWER SAUK SUMMER CHINOOK

STOCK DEFINITION AND ORIGIN

Lower Sauk River chinook are those that spawn in the Sauk River downstream of the Darrington Bridge. This stock was defined as a distinct stock based upon differences in genetic composition, spawn timing, and geographical distribution of spawning. The genetic composition is statistically different from all other Puget Sound stocks examined, including upper Sauk, upper Skagit, lower Skagit, Suiattle, and the Skagit hatchery summer and fall stocks. The spawning time is primarily in September to early October with a geographical spawning distribution from the mouth of the Sauk to the Darrington bridge at RM 21.2. Very little spawning occurs from RM 21.2 to RM 31.9 due to lack of available spawning habitat. This area separates lower Sauk from upper Sauk spawners. This timing and geographical distribution of lower Sauk chinook are in contrast to the earlier spawners in the upper Sauk. However, the spawning time is similar to that of chinook which spawn in the upper Skagit River.

The origin of this stock is native with no known significant hybridization with other Skagit stocks, based upon genetic separation differences. This stock differs genetically from the Skagit Hatchery summer stock.

STOCK STATUS

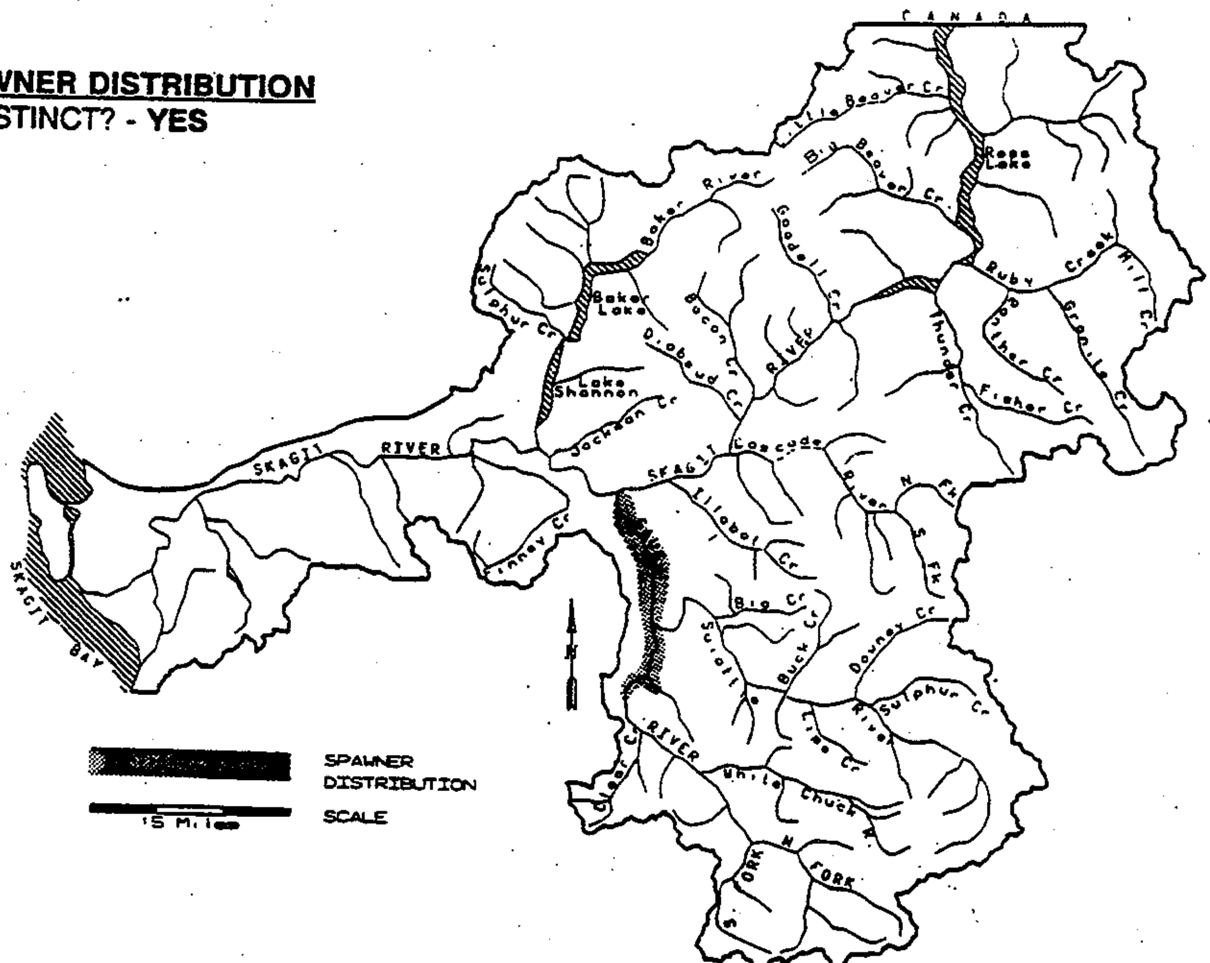
Data on total production, catches, and return per spawner do not exist for this stock. The only production data that exist are spawning escapements. Based upon escapement levels, this stock is currently classified as Depressed, due to chronically low escapement levels since 1983 compared to levels consistently achieved in the late 1970s-early 1980s. Also, escapement levels have generally been lower in odd-years than in even years. The escapement levels averaged 1,142 from 1974-1991 with an average escapement of 891 in odd years and 1,392 in even years during that same time period. It is not known whether this disparity is due to differences in production or to differences in catch levels between odd and even years. The escapement estimates are based upon counts of redds and are good indicators of relative abundance.

FACTORS AFFECTING PRODUCTION

Habitat -- The natural limiting habitat factor in the lower 13.2 miles of the Sauk River is glacial sedimentation, primarily from the Suiattle River, but also from the Whitechuck River at RM 31.9. The spawning riffles in the upper reaches become shorter and more coarse as the valley narrows and stream gradient increases.

STOCK DEFINITION PROFILE for Lower Sauk Summer Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

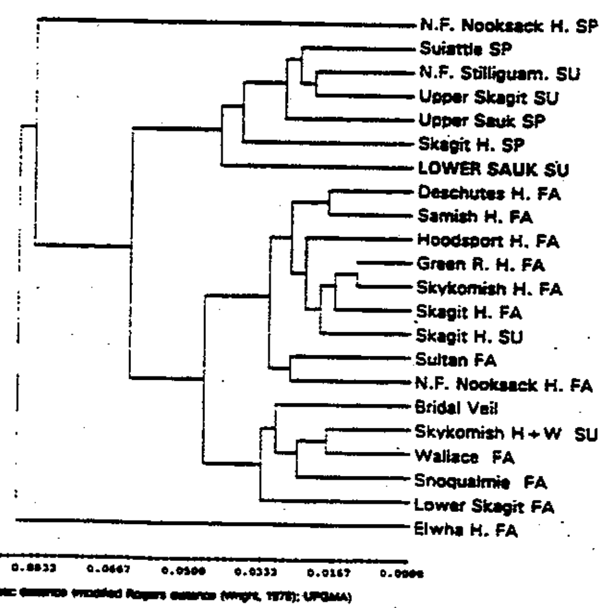


TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													**UNK**
SPAWNING													**UNK**
													YES

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Genetic data from wild fish sampled in 1986 show this stock to have distinct genetic characteristics and to be significantly different (**p**<.05) from all other Skagit and Puget Sound stocks examined.

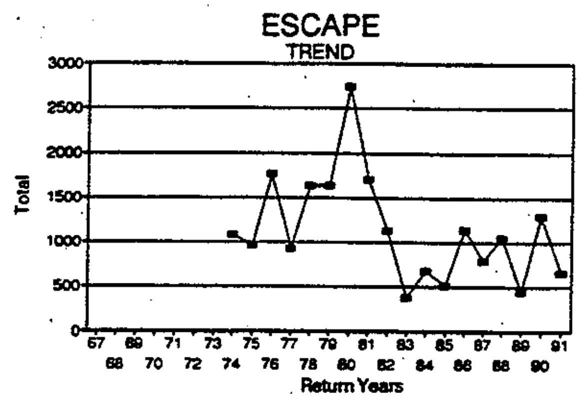


STOCK STATUS PROFILE for Lower Sauk Summer Chinook

STOCK ASSESSMENT

DATA QUALITY——> Good

Return Years	ESCAPE Total			
67				
68				
69				
70				
71				
72				
73				
74	1062			
75	964			
76	1770			
77	926			
78	1640			
79	1636			
80	2738			
81	1702			
82	1133			
83	375			
84	680			
85	515			
86	1143			
87	792			
88	1052			
89	449			
90	1294			
91	658			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Timing, Genetic

STOCK STATUS
Depressed

SCREENING CRITERIA
Chronically Low

The primary land use is logging.. Habitat impacts include increased peak flows and sedimentation. Many of the tributary mouths which were used for spawning are now unstable due to bedload aggradation and channel shifting. Recreational developments along the lower Sauk River have led to increasing bank hardening and reduction of nearshore habitat quality.

Lower river migration habitat is affected by agricultural diking, lack of large woody debris due to historic clearing and snag removal and loss of recruitment to logging, conversion to agriculture or residential use.

Harvest Management -- Lower Sauk summer chinook could be caught in net, troll or sport fisheries in Alaska, Canada, the Strait of Juan de Fuca and the San Juan Islands. They may also be caught in net fisheries in Port Gardner and the vicinity of Tulalip Bay (Areas 8A and 8D) in June and July and in sport fisheries throughout northern Puget Sound. Catch of Skagit fish in Port Gardner and the Tulalip Bay vicinity has been debated and requires further study.

Hatchery -- Hatchery operational impacts have not been determined. Chinook and coho yearlings are released into the Cascade River from the Skagit Hatchery, located near Marblemount. Effects of these releases on this wild stock have not been investigated.

Last ten years salmon releases into the Skagit basin.

Release Year	Spring Chinook	Summer Chinook	Fall Chinook	Chum	Coho	Pink	Sockeye
1982	0	808768	2100322	0	3939462	650000	0
1983	9500	0	1697900	741500	2627520	0	0
1984	58600	634500	1650000	0	2649300	74400	0
1985	36000	951400	1082000	0	1894254	210000	0
1986	85762	408200	1116600	522500	585200	364100	0
1987	141212	209000	1772000	561900	292859	0	27966
1988	80800	404900	1443500	57200	495872	1033800	57300
1989	115200	692730	1274000	72000	440377	0	57060
1990	67400	695300	1439430	52600	272344	2800	45348
1991	419300	305120	1144500	115785	548698	0	113367
MEAN	112642	567769	1472025	303355	1374589	389183	60208

The Skagit Hatchery which has a spring, summer, and fall chinook rearing and release program, is located in this part of the river. Some straying is possible.

Other Factors -- Impacts of other species on lower Sauk summer chinook have not been studied, and at this time are only conjectured. It is speculated that recent low marine survival rates may be related to increased abundances of mackerel, dogfish, or marine mammals. Poor ocean upwelling is believed to have reduced the available food for chinook; it is unknown what effect the increased abundance of Fraser sockeye may have had on this food supply. Effects of hatchery and natural production of other salmonids, as noted above, have not been examined.

SKAGIT -- UPPER SAUK SPRING CHINOOK

STOCK DEFINITION AND ORIGIN

Upper Sauk spring chinook are those that spawn in the Sauk River and its tributaries upstream from the Darrington Bridge. This stock has been classified as distinct, based upon differences in genetic composition (1986), spawn timing and geographical distribution. It has statistically significant genetic differences from spawners in the lower Sauk, lower Skagit, Suiattle, and from Skagit hatchery summer and fall chinook. The upper Sauk genetic baseline is not significantly different from the upper Skagit summer chinook baseline.

Upper Sauk spring chinook spawn from late July through early September primarily from the town of Darrington to RM 39.7 (forks). Less spawning occurs upstream of RM 39.7. Both spawn timing and distribution differ from those of chinook that spawn in the upper Skagit, lower Skagit, and lower Sauk. Timing is similar, but distribution differs from that of chinook spawning in the Suiattle and upper Cascade. There may be some interaction between upper Sauk and lower Sauk chinook but is likely to be minor because of timing differences and because there are several miles with low spawner density between upper Sauk spawning areas and the Darrington Bridge (the upper extent of lower Sauk chinook).

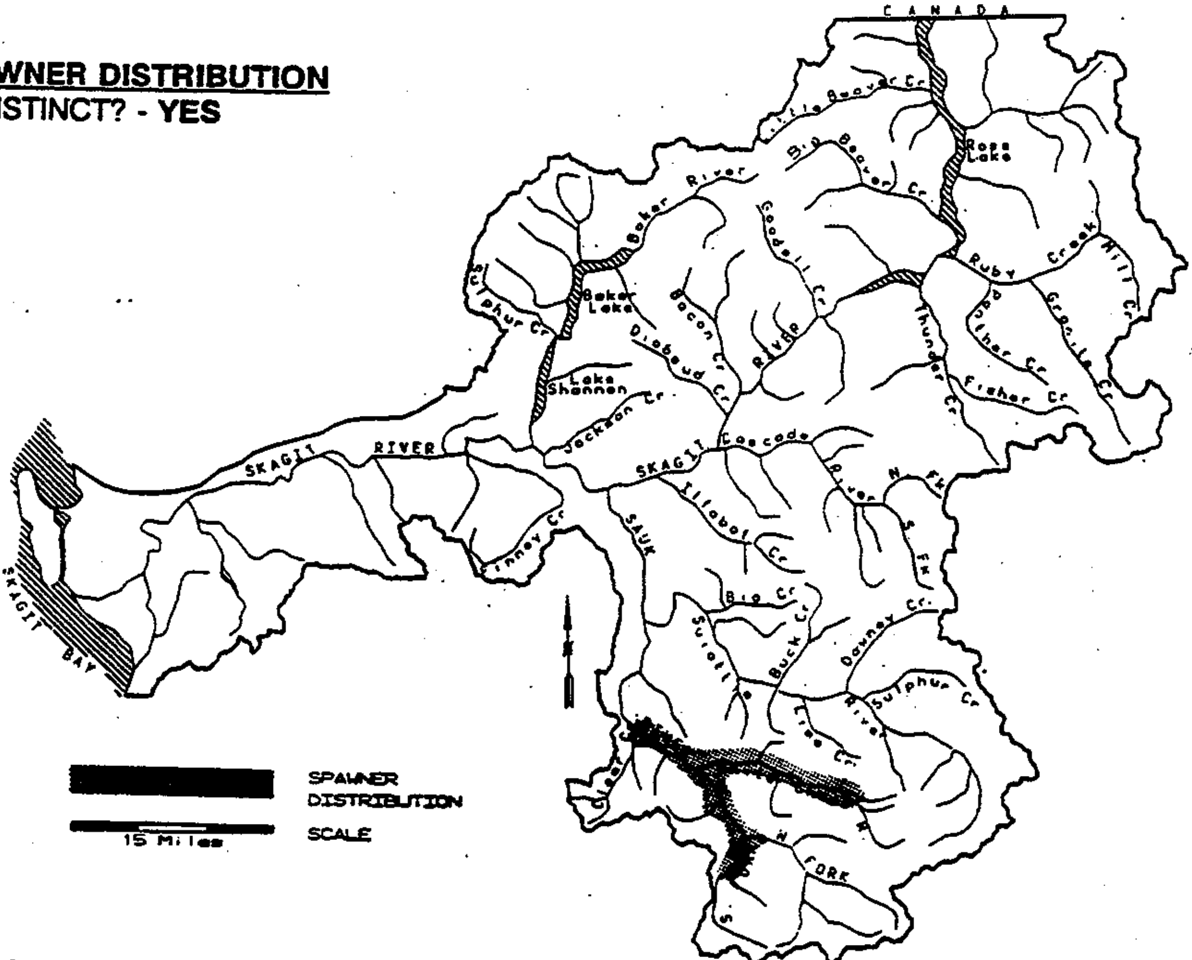
Stock origin is native, and there is no evidence of significant hybridization with other Skagit stocks. There is no hatchery production of this stock.

STOCK STATUS

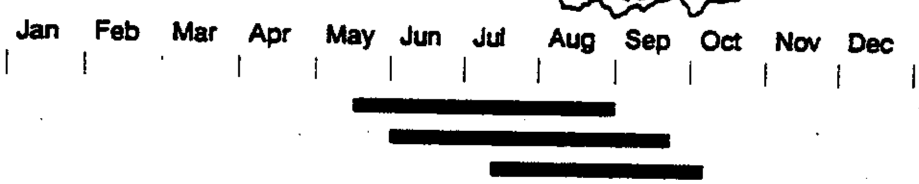
Data on total production, catches, and returns per spawner do not exist for this stock. The only production data that exist are spawning escapements. Based upon escapement levels and available spawning habitat, this stock is currently classified as Healthy. Escapement levels have averaged 580 from 1968-1991 with large variation from year to year and an upward trend since 1974.

STOCK DEFINITION PROFILE for Upper Sauk Spring Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



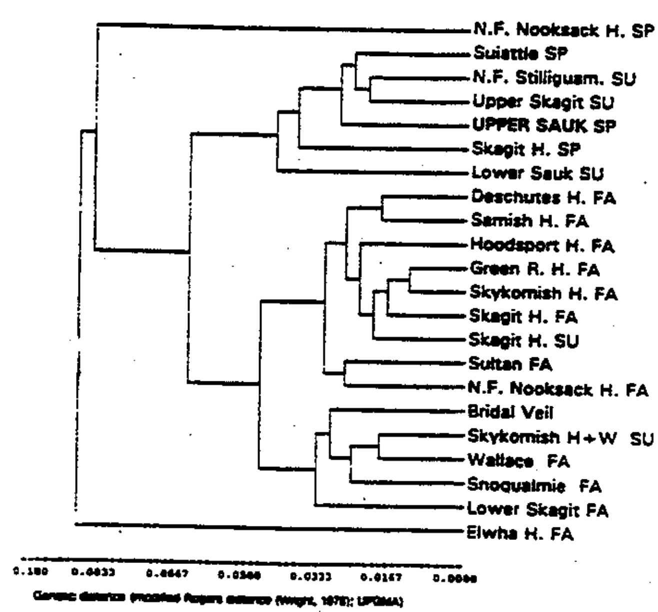
TIMING



	DISTINCT
TERMINAL RUN	**UNK**
RIVER ENTRY	**UNK**
SPAWNING	**YES**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **NO**

GENETICS - A 1986 sample of Upper Sauk spring chinook was not genetically distinct ($p > 0.05$) from a 1986 sample of Upper Skagit summer chinook. Upper Sauk springs are different from all other Skagit stocks and other Puget Sound stocks examined.

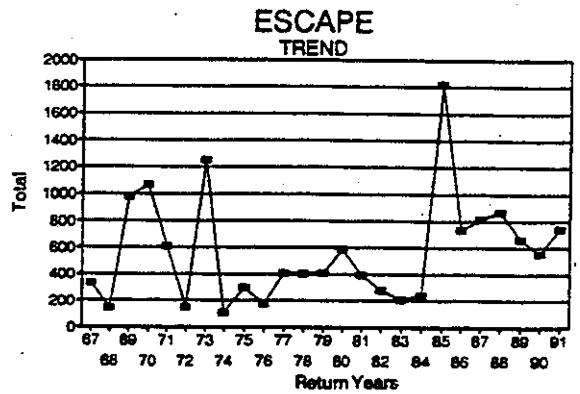


STOCK STATUS PROFILE for Upper Sauk Spring Chinook

STOCK ASSESSMENT

DATA QUALITY-----> Good

Return Years	ESCAPE Total			
67	336			
68	147			
69	978			
70	1066			
71	610			
72	150			
73	1255			
74	108			
75	300			
76	173			
77	411			
78	404			
79	411			
80	590			
81	394			
82	277			
83	202			
84	238			
85	1818			
86	737			
87	815			
88	870			
89	668			
90	557			
91	747			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution, Timing, Genetic

STOCK STATUS

Healthy

SCREENING CRITERIA

SKAGIT -- SUIATTLE SPRING CHINOOK

STOCK DEFINITION AND ORIGIN

Suiattle spring chinook are those that spawn in the Suiattle River and its tributaries. This stock was designated a distinct stock due to differences in genetic composition, spawn timing, and geographical distribution of spawning. Suiattle chinook have statistically significant genetic differences from all other Puget Sound chinook examined, including lower Skagit, upper Skagit, lower Sauk, upper Sauk, and Skagit hatchery spring, summer and fall stocks. Samples for the genetic analyses have been taken for several years (1985-1990) with no differences observed among years.

Suiattle chinook spawn primarily in late July-early September, a timing distinct from chinook in the upper Skagit, lower Skagit, and lower Sauk. The geographical distribution is different from the two regions with similar spawn timing (the upper Cascade and the upper Sauk).

The stock origin is native with no known significant hybridization with other Skagit stocks. Suiattle spring chinook were the source of the Skagit hatchery spring chinook program, which now consists of a few hundred spawners each year. Interestingly, the genetic baseline for Suiattle wild chinook is different from the Skagit hatchery spring chinook 1990 baseline. The reasons for this difference are unknown but may be due to hatchery practices or selective pressures. Thus, although Suiattle stock chinook are cultured at the Skagit hatchery, genetic changes could affect their potential to survive in their ancestral spawning grounds.

STOCK STATUS

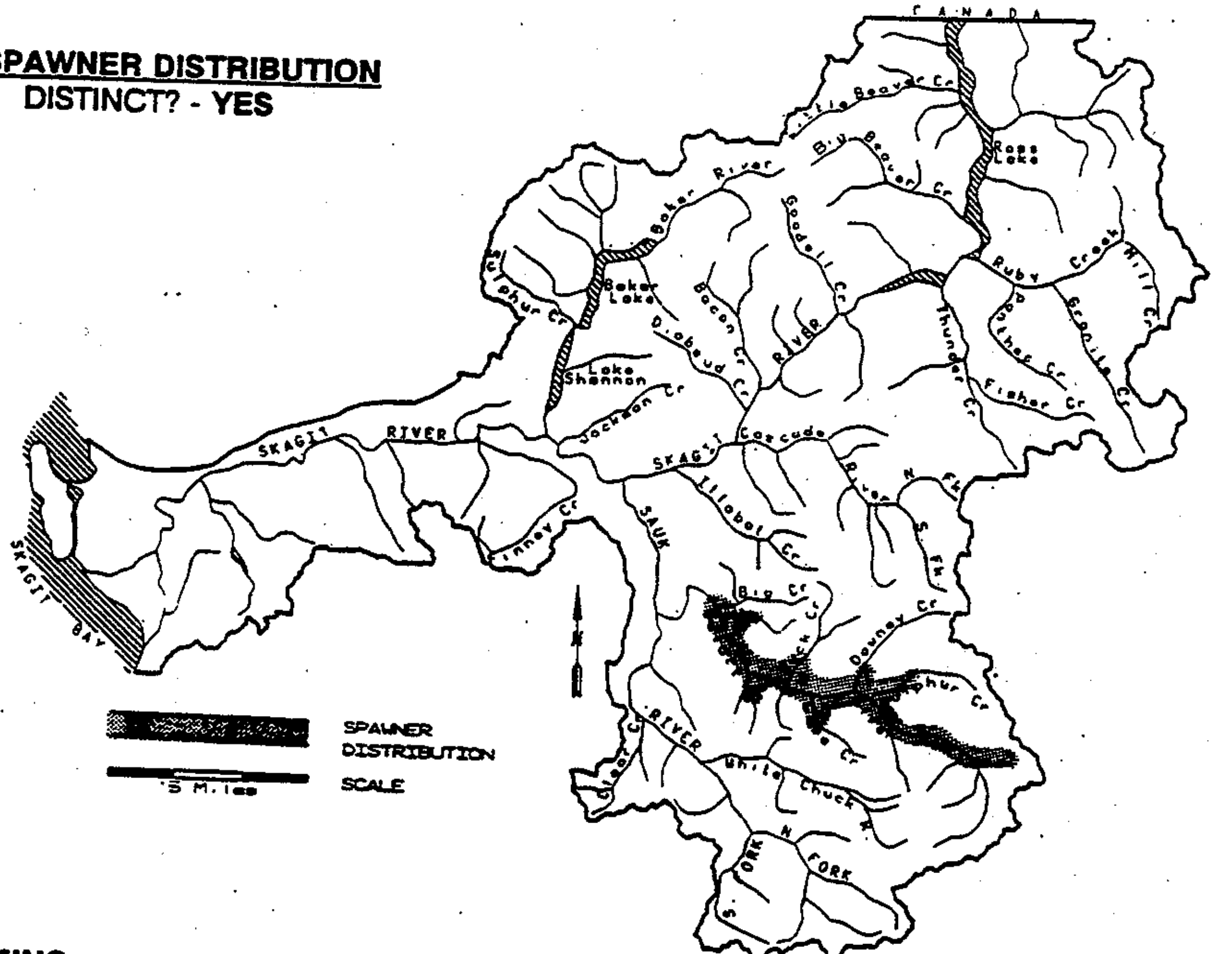
Data on total production, catches and returns per spawner do not exist for this stock. The only production data that exist are spawning escapements. Based upon chronically low escapement estimates, this stock is currently classified as Depressed. Escapement estimates average 667 from the years 1974-1991. These estimates do not show a trend during that period but are believed to be low relative to the available spawning habitat. Escapement estimates are based upon peak live and dead counts converted to fish per mile and multiplied by the miles of available spawning habitat.

FACTORS AFFECTING PRODUCTION

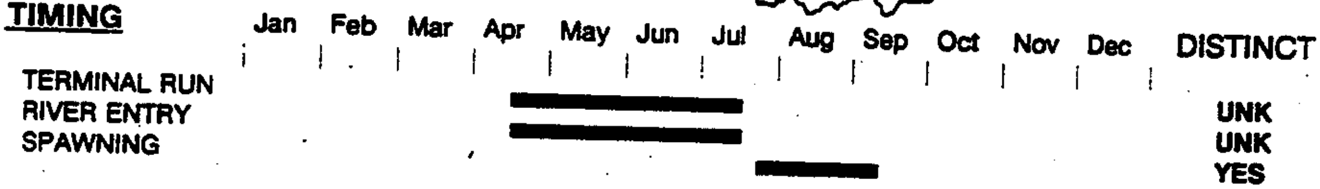
Habitat -- The Suiattle River is characterized by steep gradients, cobble substrate with sporadic patch gravel, heavy glacial sedimentation and with very cold water. These characteristics all limit natural salmon production.

STOCK DEFINITION PROFILE for Suiattle Spring Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

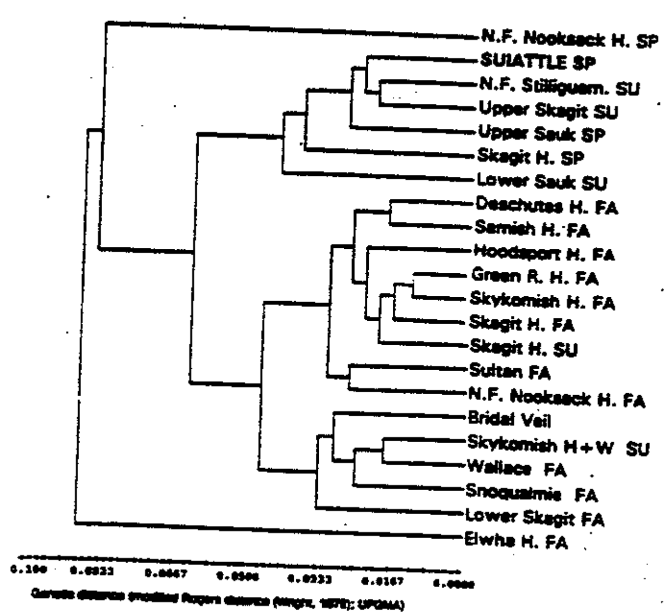


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Genetic data from Suiattle wild spawners sampled for six years (1985-1990) show no differences between years and that this stock is genetically distinct. Suiattle springs are significantly different ($p<0.05$) from other Skagit and Puget Sound stocks examined.

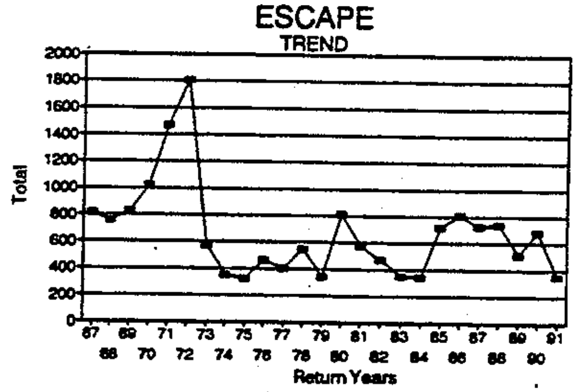


STOCK STATUS PROFILE for Suiattle Spring Chinook

STOCK ASSESSMENT

DATA QUALITY-----> Good

Return Years	ESCAPE Total			
67	818			
68	761			
69	830			
70	1020			
71	1468			
72	1804			
73	577			
74	355			
75	326			
76	460			
77	407			
78	548			
79	344			
80	816			
81	581			
82	476			
83	352			
84	345			
85	716			
86	806			
87	729			
88	740			
89	514			
90	685			
91	354			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution, Timing, Genetic

STOCK STATUS

Depressed

SCREENING CRITERIA

Chronically Low

Logging is the primary land use affecting salmon production. Critical creek mouth-spawning areas have been subjected to debris flows and gravel aggradation, with subsequent channel shifting. Since most smolts outmigrate as yearlings, summer and winter habitat conditions for juveniles come into play. Both natural conditions and human disturbances have affected rearing habitat, primarily through lack of large woody debris to form and maintain habitat and through channel shifting and pool filling.

Lower river migration habitat is affected by agricultural diking, lack of large woody debris due to historic clearing and snag removal, and loss of recruitment due to logging and conversion to agriculture or residential use.

Harvest Management -- In addition to being caught in fisheries in Alaska, Canada, the Strait of Juan de Fuca (Areas 4B, 5 and 6C), and the San Juan Islands (Areas 6, 7 and 7A), Skagit spring chinook could be also caught in net fisheries in Port Gardner and the vicinity of Tulalip Bay (Areas 8A and 8D) in June and July, and in sport fisheries throughout Puget Sound. Catch of Skagit fish in Port Gardner/Port Susan and Tulalip Bay vicinity has been debated and requires further study.

The Puget Sound Salmon Stock Review Group (1992) examined catches of Skagit spring chinook, broodyears 1981-1987. Their report indicates that fisheries in Canada account for 54% of the total adult equivalent fishing mortality for Skagit spring chinook. Puget Sound net fisheries took just over 25% of the total catch, the Puget Sound sport fishery took 17% of the total catch and Puget Sound troll fisheries took about 3% of the total catch. Alaska fisheries and Pacific Fisheries Management Council-managed ocean sport and troll fisheries accounted for less than 1% of the total catch. The Pacific Salmon Commission Joint Chinook Technical Committee's 1989 Annual Report reviewed catch data for Skagit spring chinook for 1985-1989. Their results were similar to those of the Puget Sound Salmon Stock Review Group.

No commercial net fisheries have targeted these fish in Skagit Bay or the Skagit River for several years, except in 1989 when a harvestable run was forecast, and limited sport and commercial fisheries were permitted. Since 1989 a test fishery has been conducted to gather data on hatchery/wild proportions and age composition. This test fishery catches about 40 chinook, probably spring chinook, during May and June each year. Limited tribal ceremonial fisheries have also taken place in the Skagit River in May. Because run reconstruction does not consider Suiattle chinook separately from other spring chinook terminal net harvest rates cannot be computed. However, because there are no terminal or extreme terminal commercial net fisheries (other than test or ceremonial) the terminal net harvest rate should be low.

The sport fishery in the Skagit River is normally closed from the mouth of the Cascade River downstream to Gilligan Creek until July 1 with a daily limit of two adults and the requirement that chinook over 24 inches must be released. The sport fishery is normally closed from Gilligan Creek downstream to the mouth of the river until June 16 with a daily limit of one adult chinook. The Skagit River mouth and Skagit Bay are closed from April 15 to June 15 with a two chinook daily limit and 22-inch minimum size limit.

Hatchery -- Hatchery operational impacts have not been determined. Chinook and coho yearlings are released into the Cascade River from the Skagit Hatchery located near Marblemount. Portions of spring chinook brood stock released at Skagit Hatchery originated from Suiattle tributaries.

Last ten years salmon releases into the Skagit basin.

Release Year	Spring Chinook	Summer Chinook	Fall Chinook	Chum	Coho	Pink	Sockeye
1982	0	808768	2100322	0	3939462	650000	0
1983	9500	0	1697900	741500	2627520	0	0
1984	58600	634500	1650000	0	2649300	74400	0
1985	36000	951400	1082000	0	1894254	210000	0
1986	85762	408200	1116600	522500	585200	364100	0
1987	141212	209000	1772000	561900	292859	0	27966
1988	80800	404900	1443500	57200	495872	1033800	57300
1989	115200	692730	1274000	72000	440377	0	57060
1990	67400	695300	1439430	52600	272344	2800	45348
1991	419300	305120	1144500	115785	548698	0	113367
MEAN	112642	567769	1472025	303355	1374589	389183	60208

Other Factors -- Impacts of other species on Skagit basin chinook have not been studied. It is speculated that recent low marine survival rates may be related to increased abundances of mackerel, dogfish, or marine mammals. Poor ocean upwelling is believed to have reduced the available food for chinook; it is unknown what effect the increased abundance of Fraser sockeye may have had on this food supply. Effects of hatchery and natural production of other salmonids, as noted above, have not been examined.

SKAGIT -- UPPER CASCADE SPRING CHINOOK

STOCK DEFINITION AND ORIGIN

Upper Cascade spring chinook are those that spawn in the Cascade River upstream of a gorge located approximately from RM 6.0 to RM 19.0. This stock was classified as distinct based upon geographical distribution and spawn timing. Spawning occurs in late July-early September, a timing distinct from lower Cascade and upper Skagit chinook which spawn primarily in September.

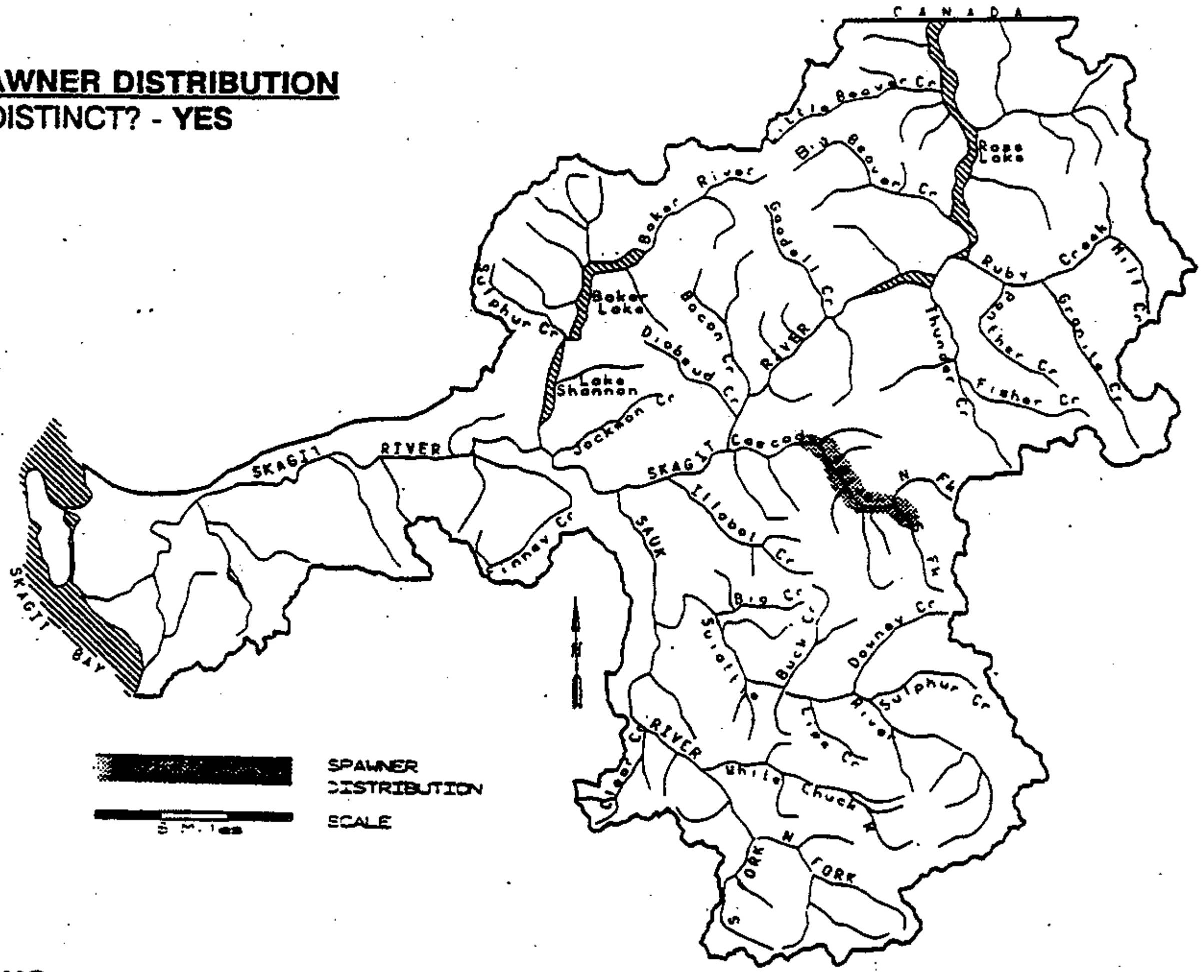
Stock origin is native. Some genetic sampling was done in 1987, but only 23 fish were sampled. Further sampling is recommended in the near future.

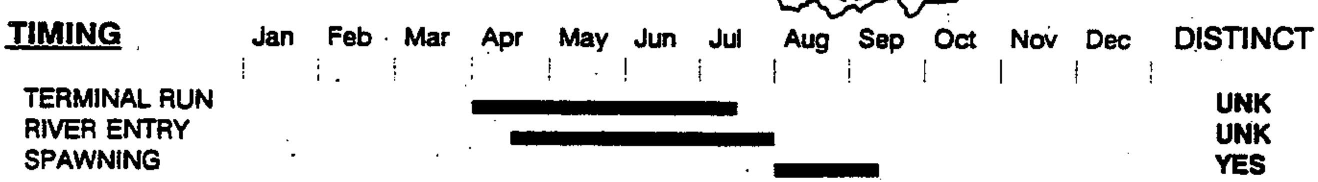
STOCK STATUS

Stock status is Unknown due to lack of consistent data. Annual peak redd counts are available and range from 17 to 103/year (1984-1991, except 1987). However, these counts are not very comparable from year to year due to inconsistent numbers of miles surveyed and inconsistent starting dates for each season.

STOCK DEFINITION PROFILE for Upper Cascade Spring Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**





BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

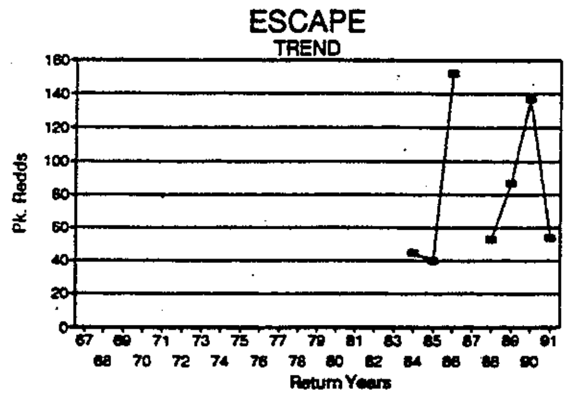
GENETICS - No data available.

STOCK STATUS PROFILE for Upper Cascade Spring Chinook

STOCK ASSESSMENT

DATA QUALITY------> Poor

Return Years	ESCAPE Pk. Redds			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84	45			
85	40			
86	152			
87				
88	53			
89	87			
90	137			
91	54			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Timing

STOCK STATUS
Unknown

SCREENING CRITERIA

OVERVIEW -- SKAGIT FALL CHUM STOCKS

MAINSTEM SKAGIT
SAUK
LOWER SKAGIT TRIBS

DEFINITION AND ORIGIN

Chum salmon are found throughout the Skagit River basin except for smaller tributaries and the upper reaches of the watershed. Preferred spawning habitats are larger tributaries, side channels, and mainstem areas with reduced flow velocity. Spawning area quality is generally good with some local degradation. Pre-emergent fry survival may be impacted by stream flow fluctuations, both naturally and as the result of releases from upstream impoundments.

Chum salmon enter the Skagit from September through January, but the peak entry time is during October and early November. Spawning occurs primarily from mid-October to late December, depending on the location and stock involved. The earliest spawning occurs in certain lower mainstem tributaries, followed by the Sauk, with the latest in the mainstem and other tributaries. Fry emerge in March and April, at which time they immediately begin to migrate to salt water. Most fry begin feeding in the estuary, although some rearing in fresh water may occur. Fry abundance in inshore marine waters reaches a peak in May and declines through June as fry move offshore and into open ocean areas. Adults return as three-, four-, and five-year-olds with four-year-olds predominant in most years. Data on fecundity and sex ratios are available.

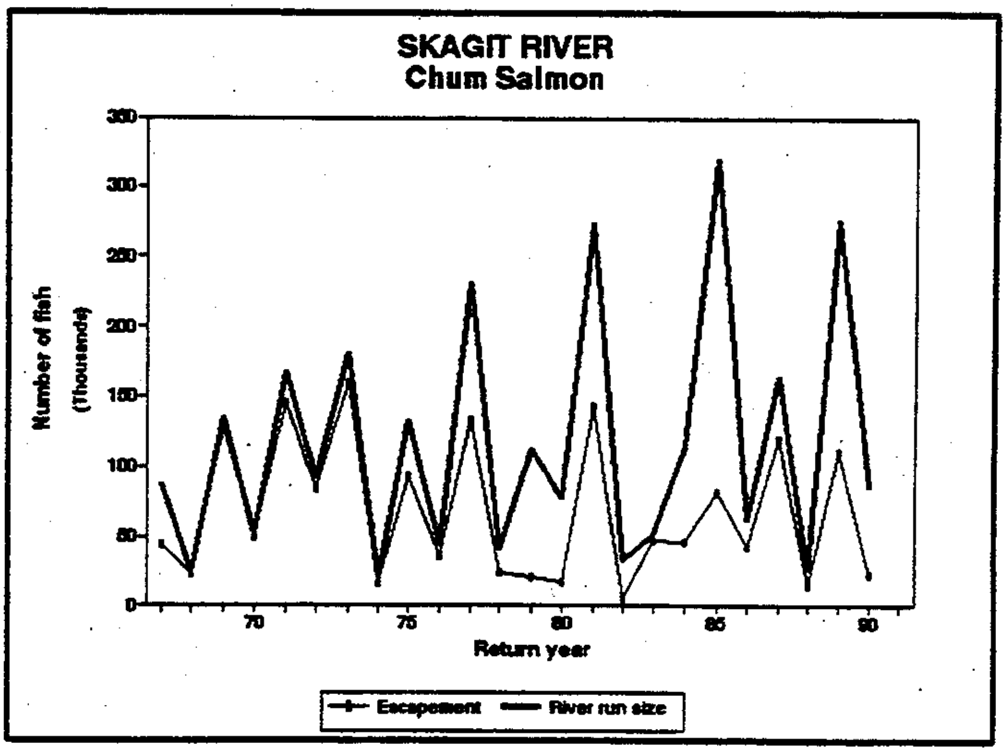
Skagit chum as a whole are separated from chum in other river systems geographically. For the purposes of this inventory, the Skagit run is tentatively separated into three stocks based on timing and geographical differences. These are: Mainstem Skagit, Sauk, and Lower Skagit Tributaries. The actual timing and geographical separations need further investigation, as there are no clear breaks either temporally or spatially among the different groups.

Skagit chum are presumed to be of native origin although chum of Grays Harbor- and Hood Canal-origin have been introduced into the system. Most production is by wild spawning; however, some limited hatchery production has occurred. Tissue sampling has shown Skagit chum to be distinct but related to other northern Puget Sound stocks. More genetic sampling and other biological studies of the various groups of Skagit chum are needed before any definite conclusions regarding stock relationships within the system can be drawn.

STOCK STATUS

Chum salmon originating in the Skagit River contribute to mixed-stock fisheries in the Strait of Juan de Fuca and the San Juan Islands. They are targeted in net fisheries in Skagit Bay and the Skagit River. Skagit chum may be intercepted in Canadian fisheries, especially in Nitnat and the Qualicum and Johnstone Strait areas, although stock breakouts are not available for these fisheries. Chum also contribute to sport fisheries in both fresh and marine waters although the catches are comparatively small.

Over the last ten years the estimated annual return of Skagit chum has ranged from 52,000 to 320,000 for even years and 26,000 to 120,000 for odd years (see figure). Estimated escapements have ranged from 47,000 to 140,000 for even years and 4,000 to 46,000 for odd years. This strong odd/even fluctuation may be due to competition with pink salmon, which are present in odd-year broods only. There are separate escapement goals for odd- and even-year returns. These goals are subject to change but at present are 40,000 for odd years and 116,500 for even years. Total returns are calculated from escapement estimates and harvest data and do not



include Canadian interceptions. Escapement estimates are based on a comparison of spawning ground counts in designated index areas to counts for the same areas during 1976 and 1977 when escapements were determined by tagging studies. The accuracy of these figures is unknown, but they are assumed to show trends because of consistency in survey methods and personnel. These counts may be relatively reliable for specific areas but do not address changes in spawner distribution outside of index areas, so their use in reflecting trends in total abundance is limited. The contributions of each of the various components of the run are unknown.

More information on each stock is presented in separate Stock Reports.

SKAGIT -- MAINSTEM SKAGIT FALL CHUM

STOCK DEFINITION AND ORIGIN

The Mainstem Skagit chum stock is separated from other Skagit chum stocks geographically and timing differences. Mainstem chum are those that spawn in the mainstem and larger tributaries from Newhalem (RM 93) downstream at least as far as Lyman (RM 34). These chum also enter the lower Cascade River, Illabot Creek, Bacon Creek and other larger tributaries. The preferred spawning habitat is in side channels and protected mainstem areas. Spawning takes primarily from mid-November to late December, usually peaking in late November or early December. They differ from Lower Skagit Tributary chum, with which they may overlap in range, by having a later spawning timing, and from Sauk chum by spawning in a different location with a later peak in time of spawning.

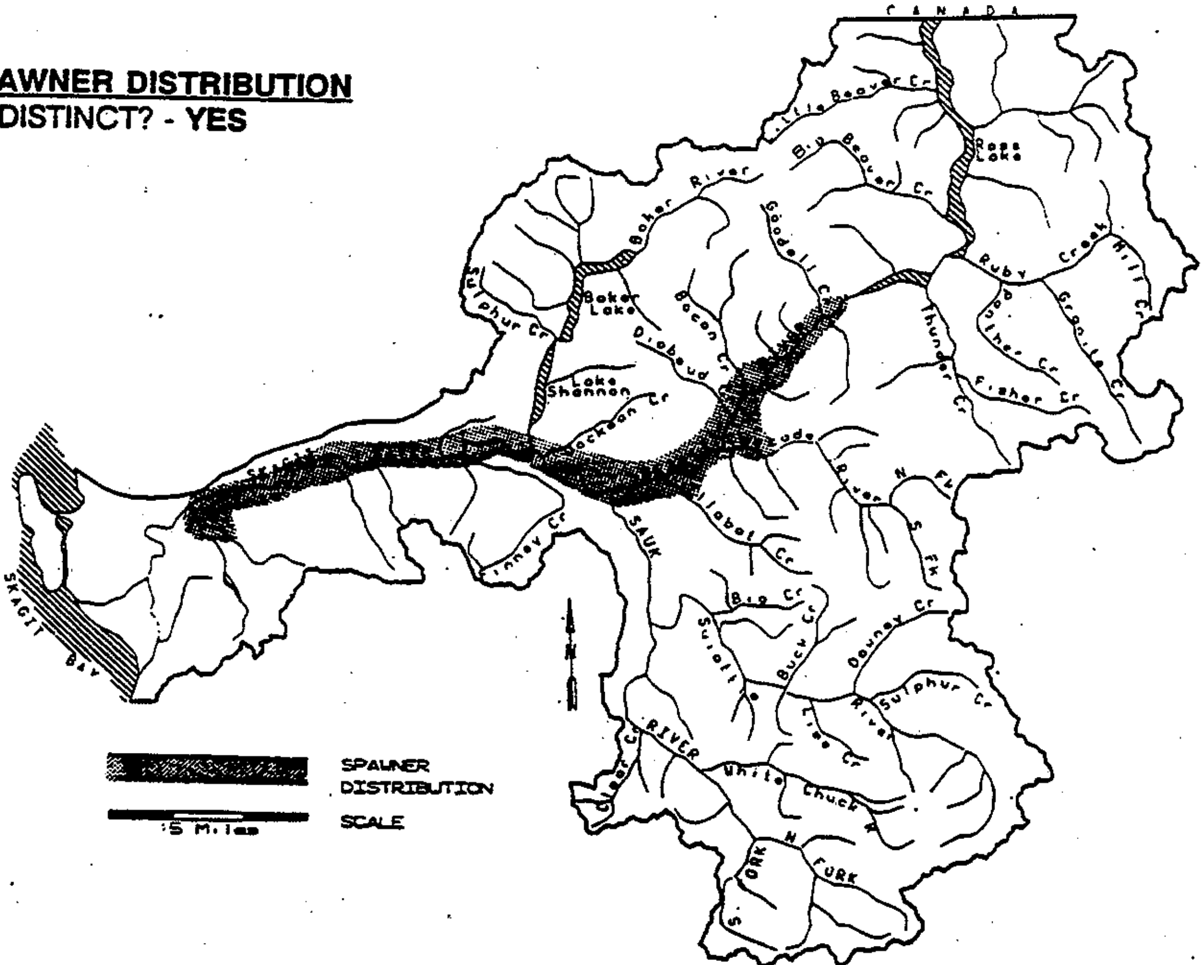
Mainstem Skagit chum are thought to be native, although chum from other systems have been introduced into the system.

STOCK STATUS

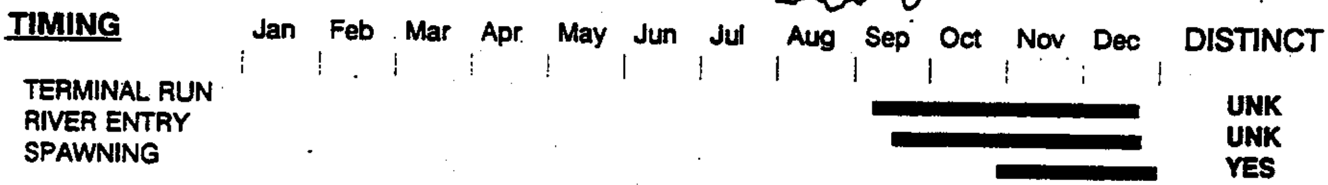
Data on total production, catches, escapement, or returns per spawner do not exist for this stock. The only production data that do exist are spawning ground index counts which are assumed to illustrate trends in abundance within this stock. Data shown on the profile are combined for the following index areas: Marblemount Slough, Illabot Slough, Illabot Creek and the mainstem Skagit from Rockport to Marblemount. Based on these data and contributions of Skagit chum taken as a whole, this stock is currently classified as Healthy.

STOCK DEFINITION PROFILE for Mainstem Skagit Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

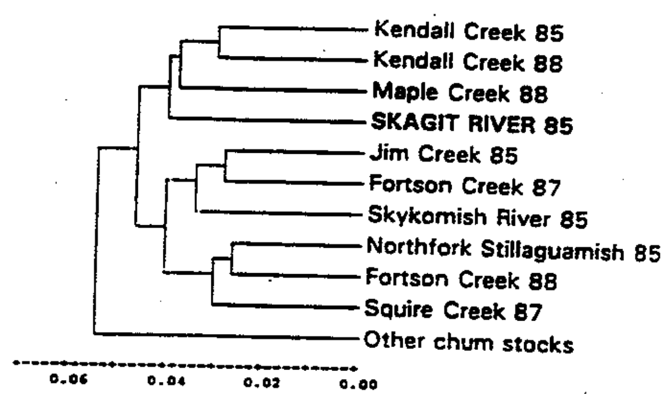


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Fish from the Skagit River were GSI sampled in 1985 and 1989 (N=100 each year). Analysis of 1985 data indicates Skagit River fish are significantly distinct (21-locus G-tests: **p**<0.05) from all other Washington and Canadian collections.



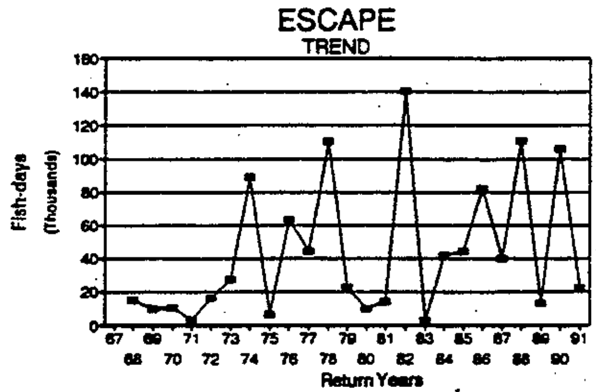
Genetic distance (modified Rogers distance (Wright,1978); UPGMA)

STOCK STATUS PROFILE for Mainstem Skagit Fall Chum

STOCK ASSESSMENT

DATA QUALITY——> NOT AVAILABLE

Return Years	ESCAPE Fish-days			
67				
68	15201			
69	9981			
70	10607			
71	3139			
72	16277			
73	27353			
74	89152			
75	6621			
76	63318			
77	44468			
78	110596			
79	22613			
80	9743			
81	14033			
82	140234			
83	2687			
84	41931			
85	44450			
86	82252			
87	40185			
88	110744			
89	13141			
90	105981			
91	22310			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution,Timing, Genetics

STOCK STATUS
Healthy

SCREENING CRITERIA

SKAGIT -- SAUK FALL CHUM

STOCK DEFINITION AND ORIGIN

Sauk chum are separated from other Skagit chum stocks by geographic and timing differences. Sauk chum are those that spawn throughout the Sauk River drainage from its confluence with the Skagit upstream at least to Falls Creek (RM 35). Presence in the Suiattle and Whitechuck drainages is unknown. The preferred spawning habitat is in side channels and protected mainstem areas with the heaviest known spawning in the Sauk Prairie area (RM 15 to 19). Sauk River spawning takes place primarily from early November to mid-December. Spawning usually peaks in late November, a week or two earlier than the Mainstem Skagit component, but later than the Lower Skagit Tributary component.

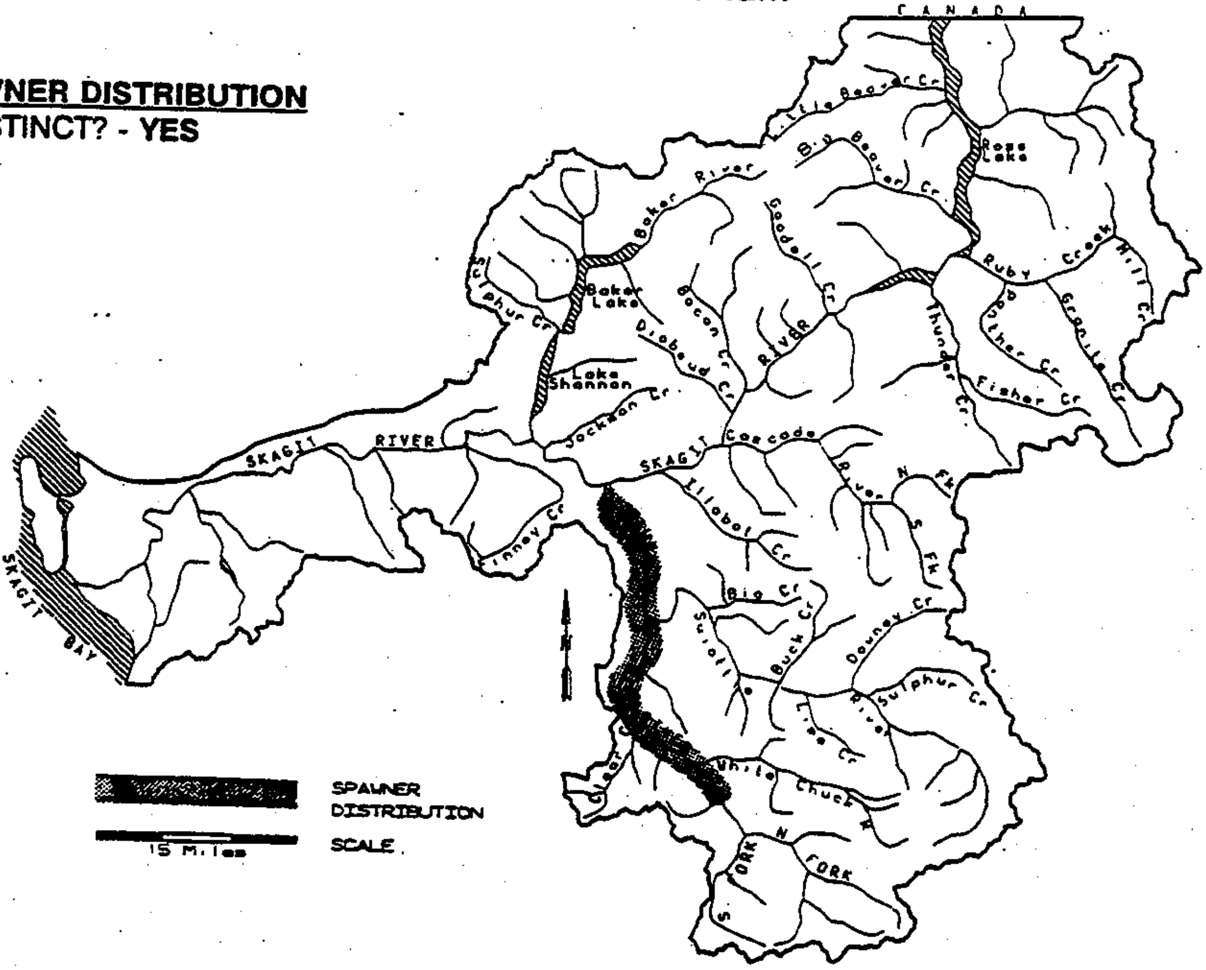
Sauk chum are thought to be native.

STOCK STATUS

Data on total production, catches, escapement or returns per spawner do not exist for this stock. The only production data that exist are spawning ground index counts which are assumed to illustrate trends in abundance within this component of the run. Index areas used in the profile for the Sauk are Dan Creek, Dan Creek Slough, and an unnamed side channel upstream from Dan Creek Slough. Due to habitat changes in the Dan Creek area and in the rest of the Sauk drainage, it is uncertain if the trends in these indexes still represent trends throughout the entire Sauk system; but, with this caveat in mind, based on these index values and performance of Skagit chum as a whole, this stock is currently classified as Healthy.

STOCK DEFINITION PROFILE for Sauk Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													UNK
SPAWNING													UNK
													YES

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

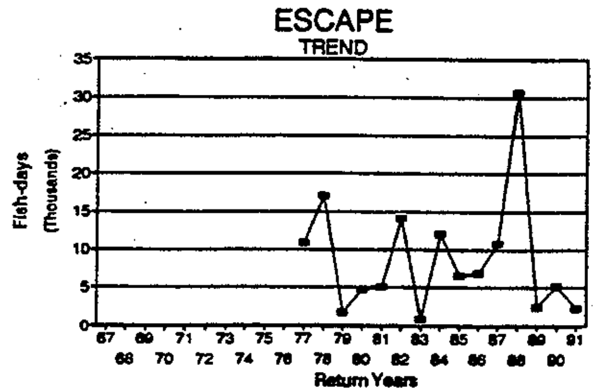
GENETICS - No GSI data for this specific stock. A partial GSI sample was collected in 1991. More sampling is planned. (see: mainstem Skagit River stock).

STOCK STATUS PROFILE for Sauk Fall Chum

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Fish-days			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77	10838			
78	17059			
79	1720			
80	4747			
81	5092			
82	14168			
83	869			
84	12070			
85	6552			
86	6959			
87	10740			
88	30621			
89	2502			
90	5186			
91	2339			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Timing

STOCK STATUS
Healthy

SCREENING CRITERIA

SKAGIT -- LOWER SKAGIT TRIBS FALL CHUM

STOCK DEFINITION AND ORIGIN

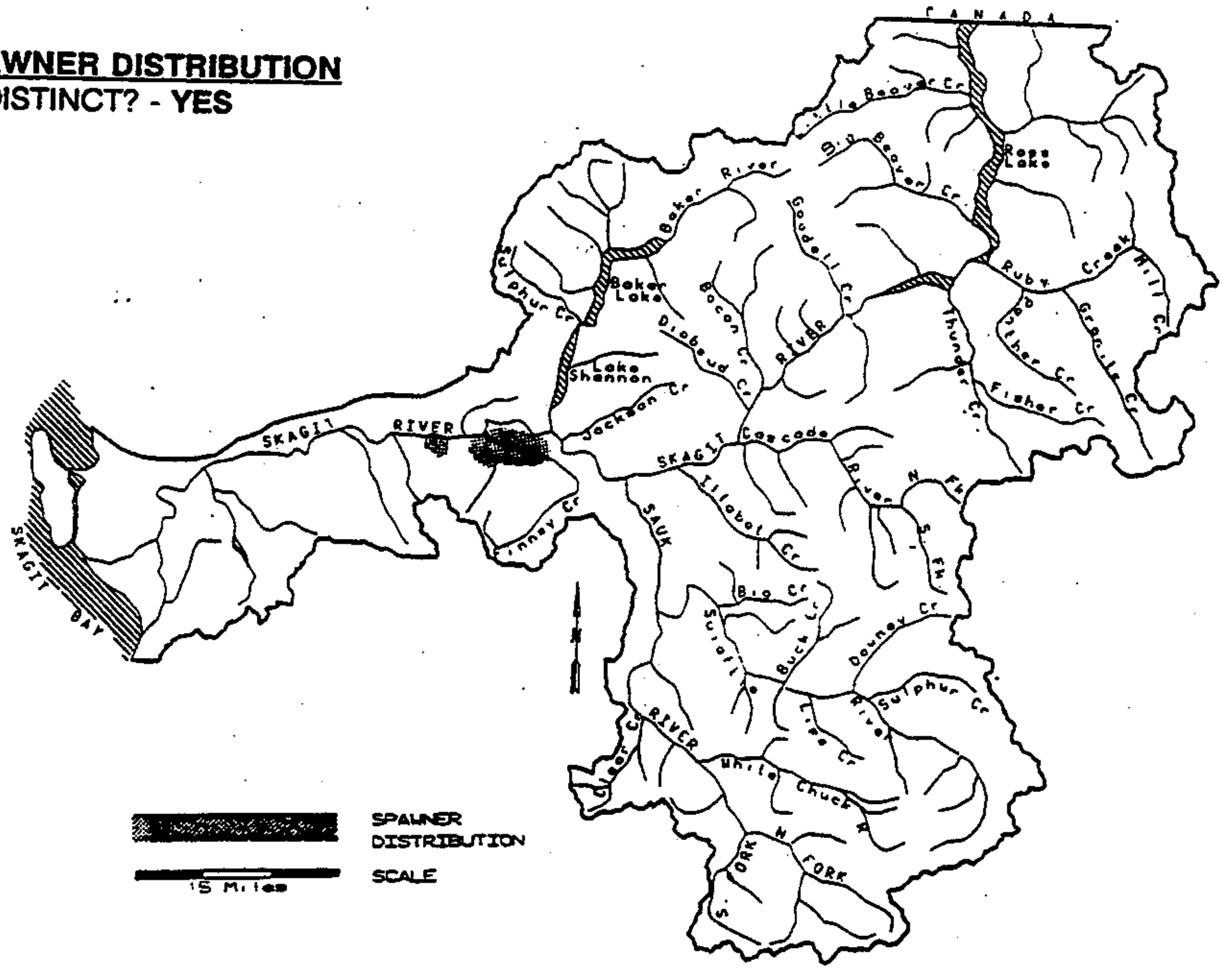
Lower Skagit Tributary chum are those that spawn in Finney Creek and certain other tributaries to the lower Skagit River. Spawning in most of the Skagit system generally occurs in November and December, peaking in late November or early December. However, chum have been found in Finney Creek as early as late September with the peak of spawning observed in late October. Atypically early chum are present in other nearby tributaries (i.e. Pressentin, O'Toole, Mill, etc.). Further investigation is needed to determine if these timing differences are consistent, since normally timed chum are also found in the lower Skagit and tributaries, including Day Creek Slough, Etach Slough and the Nookachamps drainage. Tissue samples of Finney Creek chum are being analyzed genetically to help determine if the early fish do represent a separate spawning population.

STOCK STATUS

The status of this stock is Unknown. Data on total production, catches, escapement, or returns per spawner do not exist for this stock. The lower 4.1 miles of Finney Creek are surveyed regularly during October for pink and chinook salmon and any chum present are also counted. Unfortunately, the Finney Creek watershed is very unstable and even a slight rainfall is enough to cloud the water and make surveying impossible. Because of poor visibility and a lack of staff, Finney Creek is seldom surveyed throughout the spawning period. An exception was 1976 when sufficient staff was available and favorable conditions allowed a timing curve to be developed. In other years only sporadic counts are available. In 1992, these counts were much higher than normal.

STOCK DEFINITION PROFILE for Lower Skagit Tributaries Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY													**UNK**
SPAWNING													**UNK**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

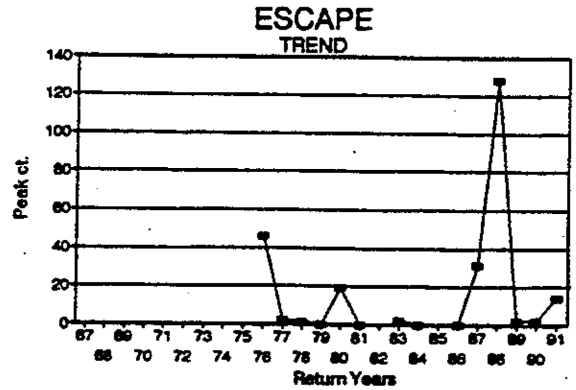
GENETICS - No GSI data for this specific stock. Sampling is planned for 1992. (see: mainstem Skagit River stock).

STOCK STATUS PROFILE for Lower Skagit Tribs Fall Chum

STOCK ASSESSMENT

DATA QUALITY------> NOT AVAILABLE

Return Years	ESCAPE Peak ct.			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76	46			
77	2			
78	1			
79	0			
80	19			
81	0			
82				
83	2			
84	0			
85				
86	0			
87	31			
88	126			
89	2			
90	2			
91	14			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Unknown

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Timing

STOCK STATUS
Unknown

SCREENING CRITERIA

FACTORS AFFECTING PRODUCTION

Habitat -- The most serious natural limiting habitat factor in this reach is glacial sedimentation of the streambed, primarily from glaciers in the Suiattle River watershed. Sedimentation has caused some spawners to avoid this area and has reduced incubation success. In addition, the Skagit mainstem and tributaries downstream of the Sauk were damaged by the 1982-1983 flood event, which blew out most tributaries and deposited loose, uncompacted gravel and sand in alluvial fans across lowland farm land. During the drought years of 1986-1987, most water in these areas went underground and stranded fish.

Impacts from logging occur in all parts of the upper watershed which contributes additional sedimentation to the mainstem. Lower river migration habitat is affected by agricultural diking, lack of large woody debris due to historic clearing and snag removal and loss of recruitment due to logging and conversion to agriculture or residential uses.

Historically this stock probably used the extensive side channels which existed prior to the advent of the agricultural dikes. This stock has probably been affected by diking and draining of estuarine wetlands and by passage problems at tide gates. Lower river tributaries have been extensively dredged.

Harvest Management -- Lower Skagit tributary chum are harvested in Canadian and United States preterminal and Skagit Bay and River terminal commercial net fisheries. In U.S. terminal fisheries (Skagit Bay and the Skagit River), this stock is managed at the exploitation rate necessary to achieve the natural escapement goal for all wild stocks in aggregate, in the Skagit River. Lack of stock identification data specific for lower Skagit tributary chum prevents a harvest level impact assessment within these fisheries. Estimates of harvest levels on Skagit River wild stocks taken as a whole are used to indicate lower Skagit tributary stock impacts.

<u>Preterminal Fisheries</u> - Skagit chum, including lower Skagit tributary chum, may be harvested in Canadian fall chum fisheries occurring after mid-September in Johnstone Strait and Georgia Strait and the outer portion of the Strait of Juan de Fuca.

Existing preterminal harvest areas in U.S. waters that may impact Skagit chum, including lower Skagit tributary chum, include Areas 4B, 5 and 6C (treaty gill net), Areas 6, 7 and 7A (treaty and non-treaty net) and Area 9 (treaty terminal net). Preterminal harvest quotas and catch projections for Skagit fall chum in 1992 are estimated as follows:

Catch Area	Total Fall Chum Quota or Catch Projection (Total fish)	Percent Skagit	Number of Skagit	Number of Lower Skagit Tribs Chum
Strait	50000	10.67	5336	[1]
Port Angeles	0	7.58	0	—
San Juan Island	50400	4.18	2105	—
Blaine/Cherry Point	50400	1.86	936	—
Admiralty Inlet	1203	0	0	—
Total	152003	—	8377	—

[1] It is unknown what percentage of the Skagit chum run is comprised of lower Skagit tributary chum.

Terminal Fisheries - The major terminal area commercial chum net fisheries impacting this stock occur in Skagit Bay and in the Skagit River. Harvest rates on the total Skagit chum run in Skagit Bay and the Skagit River averaged 28.8% and 20.4% respectively from 1988-1991 (data from WDF Chum run reconstruction, July, 1992). The combined Skagit Bay and Skagit River terminal harvest rate averaged 49.2% between 1988-1991. Because of differences in spawning timing, it is unknown what the harvest rate was on lower Skagit tributary chum.

Hatchery -- Hatchery operational impacts have not been determined. Chinook and coho yearlings are released into the Cascade River from the Skagit Hatchery located near Marblemount. No hatchery rearing programs for chum exist in the general vicinity.

Last ten years salmon releases into the Skagit basin.

Release Year	Spring Chinook	Summer Chinook	Fall Chinook	Chum	Coho	Pink	Sockeye
1982	0	808768	2100322	0	3939462	650000	0
1983	9500	0	1697900	741500	2627520	0	0
1984	58600	634500	1650000	0	2649300	74400	0
1985	36000	951400	1082000	0	1894254	210000	0
1986	85762	408200	1116600	522500	585200	364100	0
1987	141212	209000	1772000	561900	292859	0	0
1988	80800	404900	1443500	57200	495872	1033800	27966
1989	115200	692730	1274000	72000	440377	0	57300
1990	67400	695300	1439430	52600	272344	2800	57060
1991	419300	305120	1144500	115785	548698	0	45348
							113367
MEAN	112642	567769	1472025	303355	1374589	389183	60208

OVERVIEW -- SKAGIT COHO STOCKS

SKAGIT
BAKER

STOCK DEFINITION AND ORIGIN

Coho salmon in the Skagit River System spawn in tributaries throughout the system, from just above the river mouth all the way to the headwaters. They also spawn in lower densities in some of the side channels and sloughs along the mainstem Skagit, Sauk, Suiattle, and Cascade rivers. They seem to prefer to spawn in the smaller tributaries that have cover. After emerging, the fry redistribute to rearing habitat throughout the system, and may rear dozens of miles from where they were spawned. They then rear for about a year in the river, and may redistribute further during that time, particularly with the onset of winter freshets when many coho seek off-channel rearing areas. Preferred rearing habitat appears to be the slower-moving (pool) sections of streams, as well as ponds, lakes, side channels, sloughs, and swamps. Juveniles have also been observed rearing in riverine tidal habitat in the estuary. Smolts that emerge from lakes and ponds are generally larger than smolts that rear in streams. Spawning and rearing habitat quality varies throughout the system, but has generally been deteriorating over the years, due to impacts of logging, flood control, agriculture, and urban development. Bottlenecks on juvenile Skagit coho production are believed to be rearing space and cover during the low-flow periods of summer and early fall, and slow-water refuges during winter freshets. The relative importance of each bottleneck is currently under investigation.

Skagit coho smolt and outmigrate in the spring of their second year. The outmigration appears to begin in March or April, with a peak in May to early June, and it ends by July. Most coho then spend 1-1/2 years in the ocean, before returning to spawn in the fall of their third year. A very small number spend only one summer in the ocean and return as two-year-olds. The adults enter the river from July to January, with the bulk of the run entering during September and October, and the sex composition of the run shifts from predominantly male in the early part of the run to predominantly female at the end. Peak entry timing may vary by over a month, from mid-September to late October. In general, the coho returning to the Cascade and Baker rivers enter the earliest; no consistent subbasin-specific timing pattern has been observed for later-returning fish. Spawning occurs from October to late February; in general, coho in the lower tributaries spawn earlier than those farther upstream.

The origin of the run is complicated by extensive hatchery plants and transfers throughout the system of both native and non-local stocks. This has also complicated stock definition, as, despite the wide range of habitat types and run and spawning timing, there are not clear data with which to identify separate coho stocks within the Skagit. For purposes of this inventory, Baker coho have been split out as a separate stock, on the basis of their historically early run timing and smaller average size, but the remainder of the run is currently listed as one stock. This question is being studied further; in 1992, tissue samples were collected from coho in different areas throughout the Skagit in order to determine whether there are significant differences in allele frequencies between areas.

STOCK STATUS

Skagit coho are caught from the waters off northern California to Southeast Alaska, with most of them caught in ocean fisheries between northern Oregon and the northern tip of Vancouver Island, and in inside fisheries in Puget Sound and the Strait of Georgia. They are caught in troll, net, and sports fisheries, with most of the catch taken in Canada.

Estimates of smolt outmigration, total recruitment, run-size to Puget Sound net fisheries, and spawning escapement exist for varying numbers of years. Wild smolt outmigration estimates have been back-calculated to broodyear 1982 and show no discernible trend, but return rates to Puget Sound net fisheries have been well under the long-term average for the last few years, and spawning escapements have declined sharply. Escapement estimates are based on live counts in index areas compared to those observed during 1977, when a tagging study was conducted. A five-year study that began in 1986 indicates that escapements may have been significantly underestimated. Analysis of these results is continuing.

More information on each stock is presented in separate Stock Reports.

SKAGIT -- SKAGIT COHO

STOCK DEFINITION AND ORIGIN

Skagit coho are those that spawn in the Skagit System, and are not descended from Baker coho. This stock differs from other Puget Sound coho on the basis of separate spawning location (the Skagit vs. other rivers), and differs from Baker coho by having a later run timing, different spawning location and larger size. These fish have no documented unique biological characteristics and have no clearly distinct temporal distribution (spawning from October through late February). It is felt that there is limited straying of coho from other basins into the Skagit basin, but coded-wire tag recoveries have shown that some adults that return to the Skagit were tagged as smolts in the Stillaguamish, Snohomish, and Nooksack rivers, and occasionally coho from British Columbia, South Sound, and the Washington Coast are caught in the Skagit River. Separation from other stocks is tentative pending further study.

The current stock is classified as native. Although the basin has experienced some non-local coho plantings from the Marblemount Hatchery, we assume the stock to be predominately still native. The hatchery has planted mostly coho stock of native origin, taken initially from the lower Cascade (1951) and Clark Creek (1949 to present). The non-native stocks introduced were Green River (1952-1958), Samish (1952-1978), Skykomish (1959, 1969, 1974), Puyallup (1970), Minter (1970), Nooksack (1974), and George Adams (1970). Also, early annual records (1917-1919) indicate coho eggs were brought into the watershed from outside hatcheries. Again, hatchery (local and non-local stock) coho straying has occurred as evidenced by limited coded-wire tag recoveries of tagged hatchery groups on the native spawning grounds.

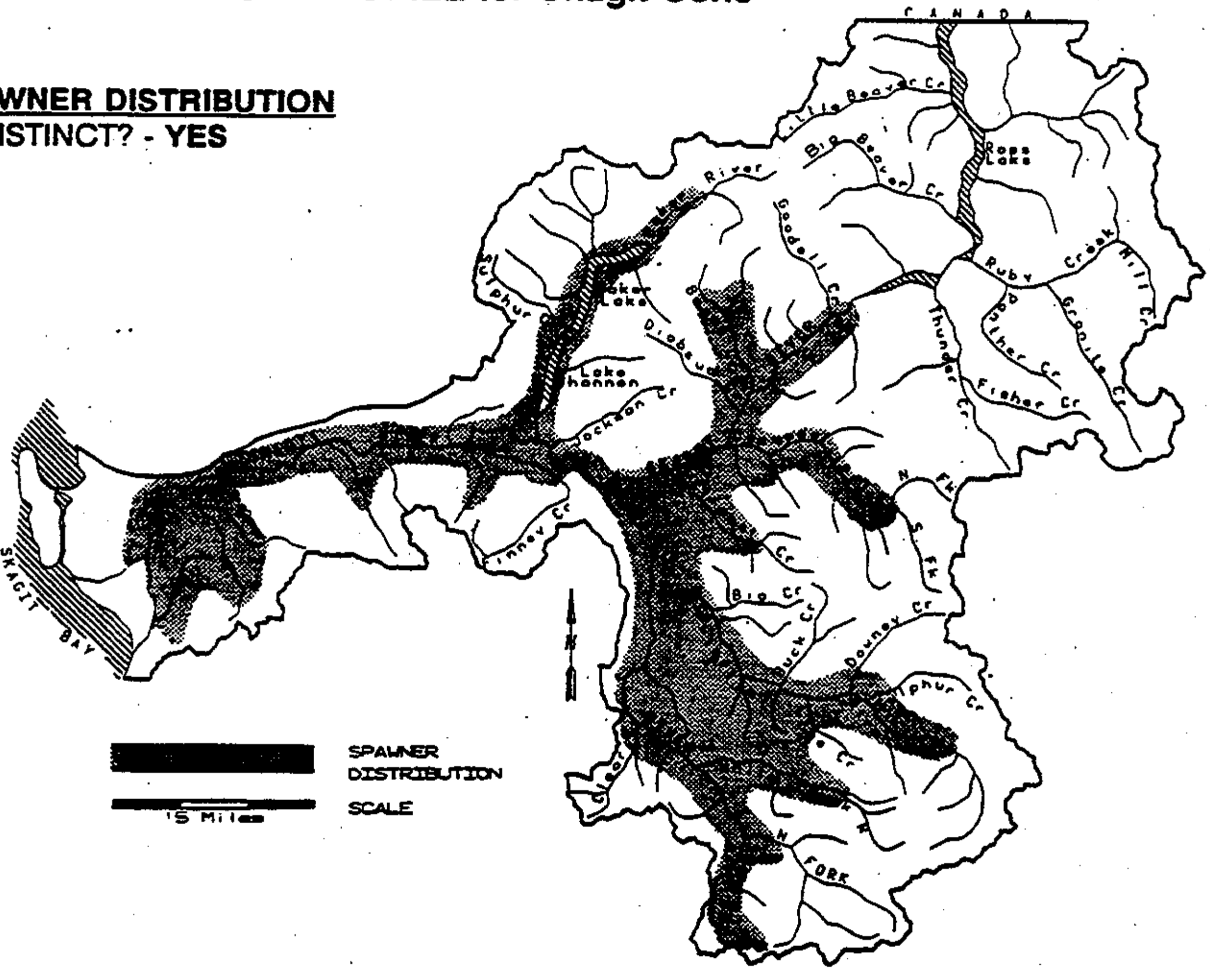
STOCK STATUS

Data on total production, catches and returns per spawner do not exist specifically for this stock; the only production data that exist are escapement and smolt outmigration data, which are assumed to represent trends in abundance within this stock.

The range of escapements over the last ten years has varied from 6,700 to 41,400 fish, with the goal being 27,000 outside the Baker. Despite relative stability in smolt outmigration estimates, the last four years have shown a short-term severe decline to the lowest numbers in the database. On this basis, the Skagit coho stock is currently classified as Depressed.

STOCK DEFINITION PROFILE for Skagit Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													UNK
RIVER ENTRY													UNK
SPAWNING													UNK

BIOLOGICAL CHARACTERISTICS
DISTINCT? -**UNKNOWN**

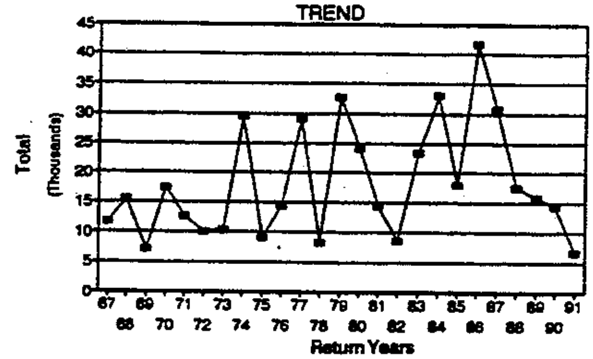
STOCK STATUS PROFILE for Skagit Coho

STOCK ASSESSMENT

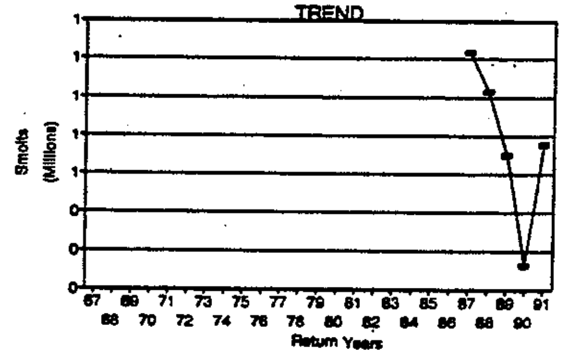
DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Total	JUVENILE Smolts		
67	11700			
68	15500			
69	7100			
70	17500			
71	12700			
72	10000			
73	10300			
74	29500			
75	9100			
76	14300			
77	29100			
78	8200			
79	32600			
80	24200			
81	14400			
82	8600			
83	23400			
84	33000			
85	18000			
86	41700			
87	30800	1235600		
88	17600	1030100		
89	15900	700700		
90	14300	123700		
91	6600	755000		

ESCAPE
TREND



JUVENILE
TREND



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Composite

STOCK DISTINCTION
Distribution

STOCK STATUS
Depressed

SCREENING CRITERIA
Short-term Severe Decline

FACTORS AFFECTING PRODUCTION

Habitat -- Approximately 25% to 35% of the potential freshwater coho production has been lost due to flood control, logging, hydropower, agriculture, and other activities (Beechie et al. in press). Most (about 75%) of the loss has been caused by flood control (diking) that has eliminated mainstem side channels and distributaries. Most of the remaining loss has been caused by improperly-placed culverts, forest practices, and hydropower. Estuarine losses have not been precisely quantified, but it has been reported that 90% of the river delta wetlands have been lost (Puget Sound Salmon Stock Review Group, 1992).

Harvest Management -- Skagit coho have been caught in ocean fisheries from Northern California to Southeast Alaska, and inside fisheries throughout Puget Sound, the Strait of Juan de Fuca, Georgia Strait, Johnstone Strait, and the Skagit Bay and River. Most recoveries occur between Cape Falcon, Oregon, and the northern end of Vancouver Island. The largest single intercepting fishery on Skagit coho is the West Coast Vancouver Island troll fishery, which currently operates under a fixed quota for coho catch. All other Canadian fisheries have no quota, and are not managed for U.S. coho. Within the U.S., ocean fisheries north of Cape Falcon, Skagit River fisheries, and marine fisheries in Puget Sound, with the exception of fisheries south of Skagit Bay, are all managed collectively to achieve an annual escapement target for Skagit coho. Although fisheries south of Skagit Bay are not managed for Skagit coho, significant numbers are intercepted in these fisheries.

From 1988-1990, an average of 90% of the harvest of Skagit coho was taken in preterminal areas. Of this, 65% was taken in Canadian fisheries, and 35% was taken in U.S. preterminal fisheries. About 10% of the harvest was taken in the terminal area. The total harvest rate (landed catch only) on Skagit coho was approximately 70% during this period (Puget Sound Salmon Stock Review Group, 1992).

Hatchery -- Hundreds of thousands of chinook, coho, and steelhead smolts are released into the Skagit River each year. In some years, hundreds of thousands of coho fry have also been planted throughout the Skagit basin. The origin of the hatchery stock is not entirely clear, but it is believed to originate primarily from Clark Creek (a Skagit tributary), with some input from Baker River and outside stocks (e.g. Green River). This stock has been cultured at the Skagit Hatchery for several generations, and outplanted to many locations throughout Puget Sound.

Study of hatchery impacts has not been completed. Because the Skagit is managed for natural production, hatchery returns have not increased the harvest rate. Tagged coho released from the Skagit Hatchery (hatchery strays) have been recovered in small numbers on spawning grounds in the vicinity of the hatchery. More significant numbers of tagged returns from off-station plants have been recovered throughout the Skagit. In 1992, tissue samples were collected from coho throughout the basin in order to analyze genetic similarities among different areas.

Last ten years salmon releases into the Skagit basin.

Release Year	Spring Chinook	Summer Chinook	Fall Chinook	Chum	Coho	Pink	Sockeye
1982	0	808768	2100322	0	3939462	650000	0
1983	9500	0	1697900	741500	2627520	0	0
1984	58600	634500	1650000	0	2649300	74400	0
1985	36000	951400	1082000	0	1894254	210000	0
1986	85762	408200	1116600	522500	585200	364100	0
1987	141212	209000	1772000	561900	292859	0	27966
1988	80800	404900	1443500	57200	495872	1033800	57300
1989	115200	692730	1274000	72000	440377	0	57060
1990	67400	695300	1439430	52600	272344	2800	45348
1991	419300	305120	1144500	115785	548698	0	113367
MEAN	112642	567769	1472025	303355	1374589	389183	60208

Other Factors -- Impacts of other species on Skagit coho have not been studied. It is speculated that recent low marine survival rates may be related to increased abundances of mackerel or marine mammals. Poor ocean upwelling is believed to have reduced the available food for coho; it is unknown what effect the increased production of Fraser sockeye may have had on this food supply. Effects of hatchery and natural production of other salmonids, as noted above, have not been examined.

SKAGIT -- BAKER COHO

STOCK DEFINITION AND ORIGIN

Baker coho are those that are descended from coho spawned in the Baker System prior to the construction of the dams. This stock is distinguished from other Skagit coho on the basis of location of spawning (Baker River system), river entry timing (river entry is July-early August vs. the September-October timing of other Skagit coho, spawning timing (January-February) which is somewhat later than spawners in lower Skagit tributaries, and about the same time as upper tributary spawners, and small size (average size is two to four pounds) vs. the six- to seven-pound-average of other Skagit coho. It is unclear whether these differences are genetic or are caused by rearing in the Baker Lake environment. Separation is tentative pending additional analyses.

This stock originated in the Baker system as an early returning (August) and late spawning unique group of smaller fish. Since the construction of the two dams on the Baker River, returnees have been trapped and hauled above the dams and released to spawn. Downstream migrating smolts have been severely impacted. Also, "normal" Skagit coho have been caught in the Baker trap and transported to the upper spawning grounds, causing possible hybridization. Skagit (Clark Creek) stock coho have been released consistently in the Baker system such that possible hybridization could have resulted. In 1971, some Baker River fish were taken to the Skagit Hatchery to establish a Baker brood stock, that is cultured to this day. However, hybridization with the Clark Creek stock has occurred and it is questionable whether a "true" Baker stock exists at that facility. It is possible that strays from that program have established a population in the Cascade River, where early-run coho are also found. In addition, Baker coho have been transported to systems outside the Skagit (e.g. Hood Canal, South Sound).

STOCK STATUS

It is uncertain what proportion, if any, of the numbers shown in the Stock Profile apply to true Baker coho, and what proportion apply to Skagit coho. In addition, coded-wire tag data have shown that at least a few of the adults that return to the Baker were tagged as smolts in other Skagit tributaries, at Marblemount, and even in the Stillaguamish and Nooksack rivers. Because of these uncertainties, the Baker coho stock is currently classified as Unknown.

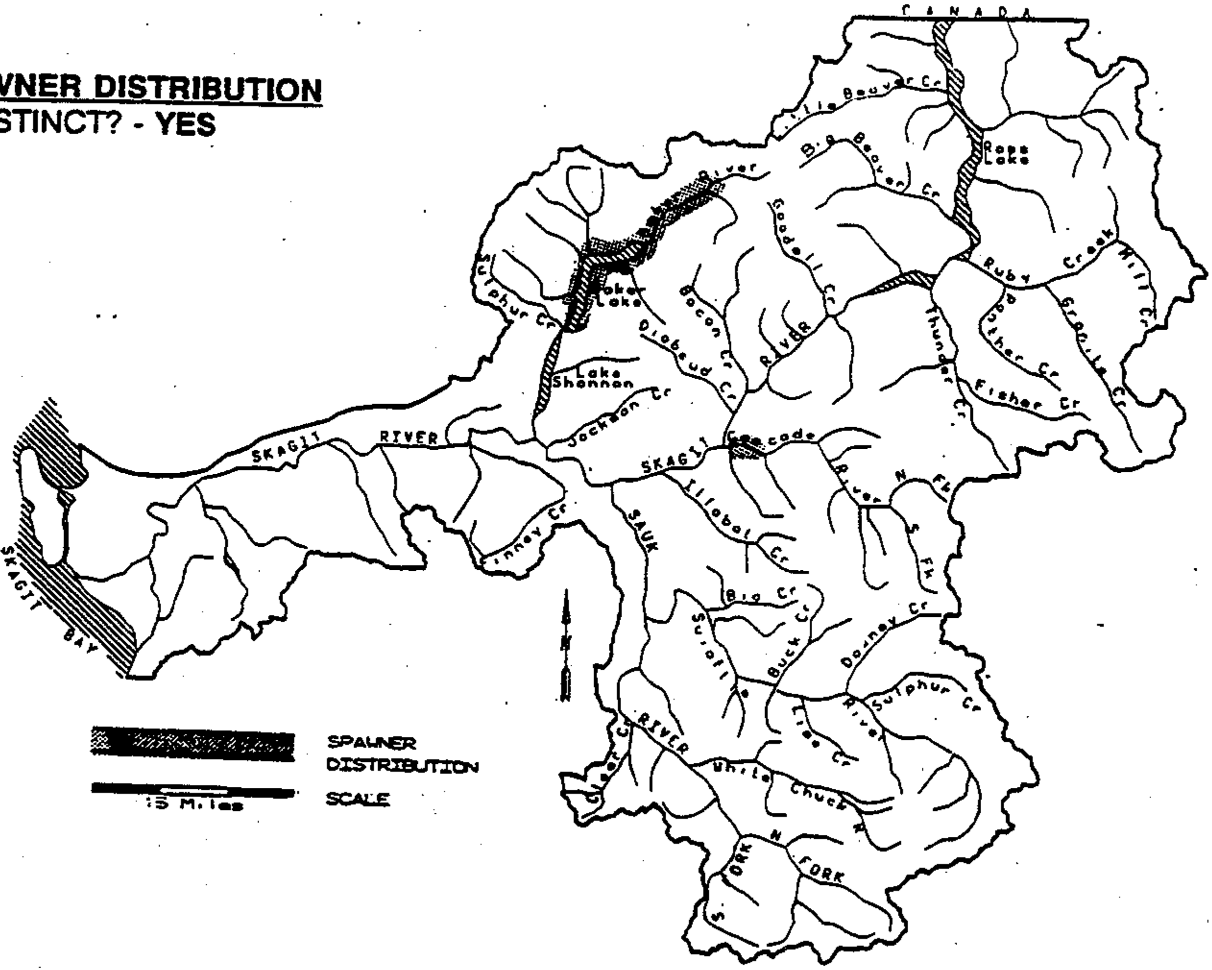
FACTORS AFFECTING PRODUCTION

Habitat -- The primary natural limiting factor for this stock is probably summer low flows in Baker River and tributaries to Baker Lake, but the loss of estuarine wetlands, and effects of other species, may also be important. The primary human limiting

STOCK DEFINITION PROFILE for Baker Coho

SPAWNER DISTRIBUTION

DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY													**YES**
SPAWNING													**YES**

BIOLOGICAL CHARACTERISTICS

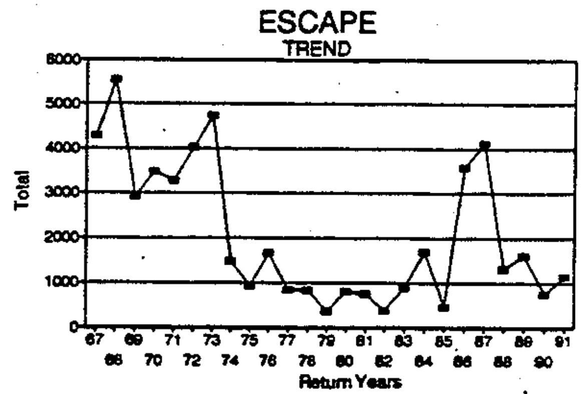
DISTINCT? - **UNKNOWN**

STOCK STATUS PROFILE for Baker Coho

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Total			
67	4287			
68	5528			
69	2913			
70	3469			
71	3280			
72	4030			
73	4739			
74	1491			
75	940			
76	1660			
77	851			
78	835			
79	360			
80	814			
81	750			
82	391			
83	901			
84	1698			
85	463			
86	3575	8496		
87	4116	3293		
88	1320	26511		
89	1603	36785		
90	750	19877		
91	1146	28743		



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Unknown

PRODUCTION TYPE

Composite

STOCK DISTINCTION

Distribution, Timing

STOCK STATUS

Unknown

SCREENING CRITERIA

factor is the presence of two hydroelectric dams on the lower river operated by Puget Power. Adults are transported around the dams by truck from a trap and haul facility near Concrete. However, smolt migration is severely limited by the dams. Trapper devices called gulpers are not adequate in passing the smolts around the dams, but attempts have been made in recent years to improve gulper operations. Fluctuations in reservoir levels may cause de-watering of redds in reservoir tributaries.

Harvest Management -- Coded-wire tag data indicate that the general distribution and exploitation rate comments under "Skagit Coho" apply also to tagged Baker coho releases. Because of differences in timing and size, however, their distribution is not exactly the same as that of other Skagit coho. Although the differences have not been analyzed statistically, it appears that Baker coho have both a lower marine survival rate, and a somewhat lower exploitation rate, than other Skagit hatchery coho.

Hatchery -- Skagit (Clark Creek) coho have been released for many years into the Baker River, and could have hybridized with the naturally-spawning local stock. In 1971-1973, Baker fish were taken to the Skagit Hatchery to establish a Baker hatchery brood stock that is cultured to this day. However, hybridization with the Clark Creek stock has definitely occurred at the hatchery, and it is questionable whether a "true" Baker stock exists at that facility. This stock has also been outplanted to Hood Canal Hatchery, Issaquah, Sequalitchew, Fox Island, and other facilities and may be less hybridized at some of them.

Last ten years salmonid releases into the Baker basin.

Release Year	Coho	Sockeye	Kokanee
1983	91000		
1984	571800		
1985	122466		
1986			
1987	108245	27966	
1988	155379	57300	
1989	105140	57060	
1990	37409	45348	
1991	235098	113367	
1992	313300	107945	256256

Other Factors -- The comments on Other Factors under Skagit coho apply also to Baker coho. In addition, there may be negative interactions in Baker Lake between wild Baker coho and other species that have been planted there or are naturally resident in the lake. Baker coho may be hooked, as juveniles, in lake sports fisheries for other species. These interactions have not been studied in any detail.

OVERVIEW -- SKAGIT PINK STOCK

SKAGIT

STOCK DEFINITION AND ORIGIN

Pink salmon spawn throughout the Skagit River drainage. Mainstem spawning occurs from Newhalem (RM 93) downstream at least to Sedro Woolley (RM 23). Spawners also use the Sauk River as far as the forks (RM 40) and penetrate the South Fork Sauk for at least two miles. Tributaries used for spawning include Day, Finney, Illabot, Diobsud, Bacon and Goodell creeks, the Cascade River, and larger tributaries of the Suiattle River. The heaviest spawning is in mainstem areas. Tributary spawning may depend on flow levels with higher flows attracting more fish. The quality of the spawning area ranges from poor to fair in the mainstem below Rockport and in Day and Finney creeks, to good to excellent in the mainstem above Rockport and in Bacon, Diobsud, and Illabot creeks and the Cascade River.

Pink salmon enter the Skagit as early as late July. River entry peaks in late August but continues into early October. Spawning begins in headwater areas (i.e. Suiattle tributaries and upper Sauk) in late August. Mainstem spawning begins in early September and continues to late October, usually peaking in early October. There tends to be a progression in spawning downstream with time. The heaviest spawning is found in the mainstem from Marblemount (RM 78) upstream to Newhalem. Spawning takes place during odd-numbered years. Fry emerge in February and March and immediately begin migrating downstream. Presence in inshore waters peaks in April and May, after which fry begin to move offshore and toward open ocean waters.

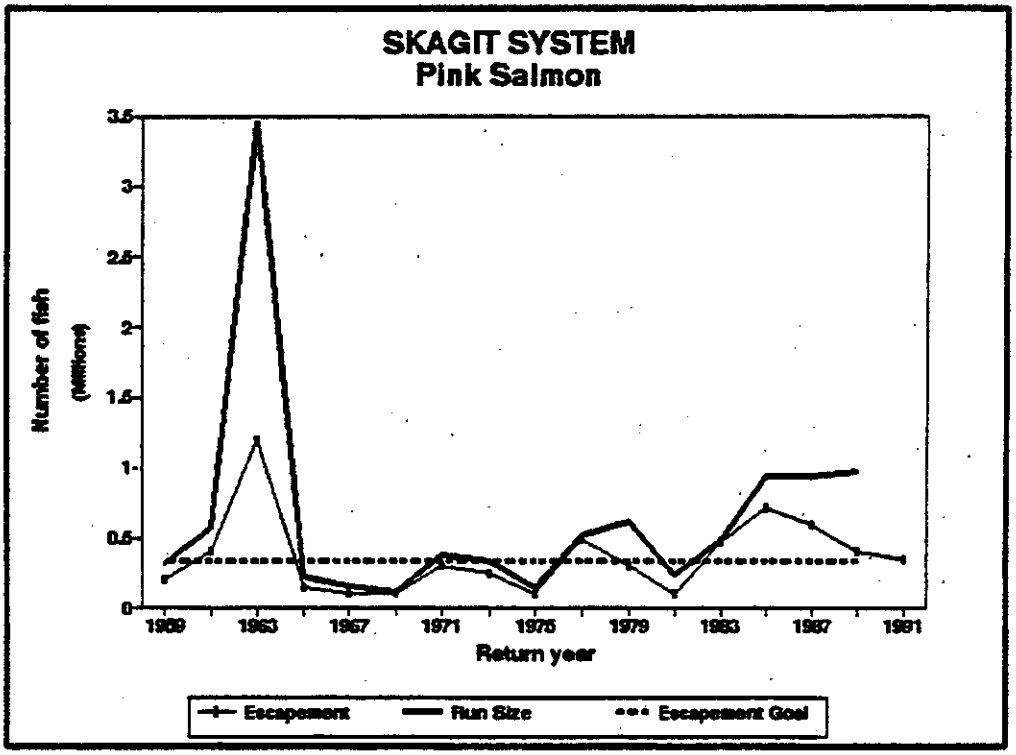
Skagit pinks are assumed to be of native origin with only negligible hatchery influence. The only known introductions of large numbers of pinks were of an even-year stock which evidently did not become established, although even-year returning individuals are occasionally encountered.

STOCK STATUS

The Skagit pink stock is the largest in Washington State with total run size (including Canadian and U.S. harvest) estimated to range from 197,000 to 1,364,000 over the last ten cycles. Escapement estimates have ranged from 100,000 to 710,000 (see figure). Skagit pinks are caught in fisheries in Washington and Canada, with a significant portion of the total run caught in Canada. Within Washington waters, Skagit pinks are taken in various mixed-stock net, troll, and sport fisheries. They are also targeted by net fisheries in Skagit Bay and the Skagit River and are an extremely popular sport fish in the river for both shore and boat fishers.

Escapement estimates are based on a comparison of spawning ground counts in designated index areas to counts for the same index areas made during 1959, 1961 and 1963, when mark-and-recapture tagging studies were conducted. The accuracy of the escapement estimates is unknown due in part to limitations in the original studies and the time elapsed since they were conducted. However, the relative value is good for showing trends because of consistency in survey methods and personnel.

More information on this stock is presented in the following Stock Report.



SKAGIT -- SKAGIT PINK

STOCK DEFINITION AND ORIGIN

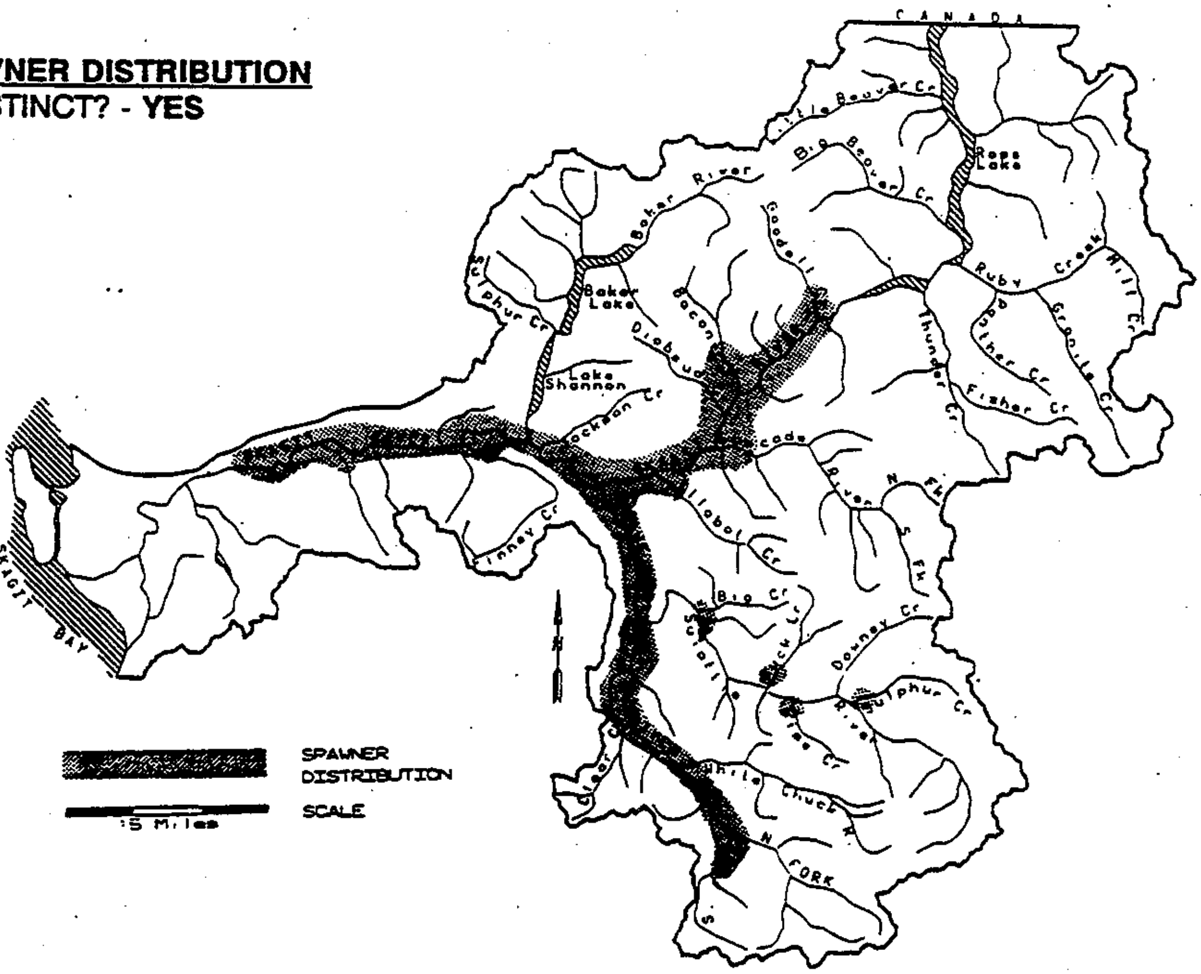
Skagit River pink salmon are those that spawn in the Skagit River System. They are considered to be a separate stock because they are separated geographically from other pink salmon stocks. Genetic analysis has not found significant differences among fish from various locations within the system.

STOCK STATUS

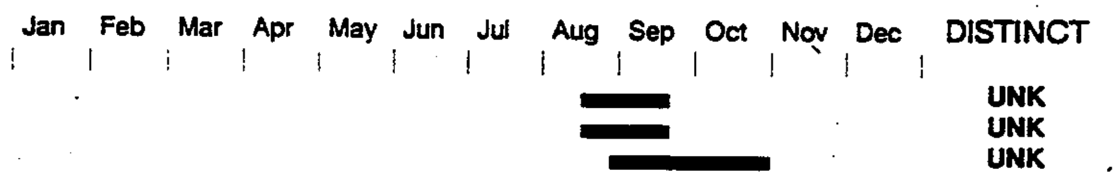
Skagit pinks are currently classified as Healthy. This stock has continued to support fairly large harvests for many years while maintaining escapement levels in the hundreds of thousands. Total returns have ranged to nearly 1.4 million in recent years, with the adult return rate appearing to vary in six-year cycles. The early spawning component in the Sauk and Suiattle drainages has been increasing from very low levels since the late 1970s, although it still represents a minor fraction of total run.

STOCK DEFINITION PROFILE for Skagit Pink

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

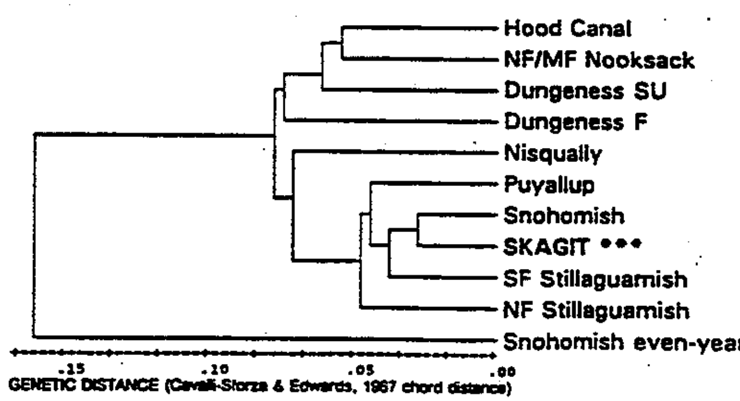


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Stock is significantly different from all other Washington stocks [collections from mainstem, upper Sauk River, Finney and Bacon creeks(N=559); 28-locus G-tests: p<0.001].



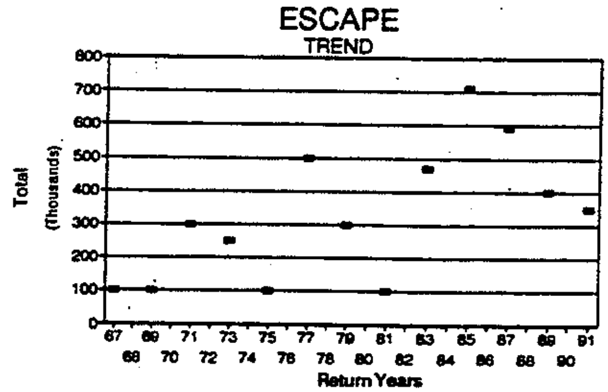
STOCK STATUS PROFILE for Skagit Pink

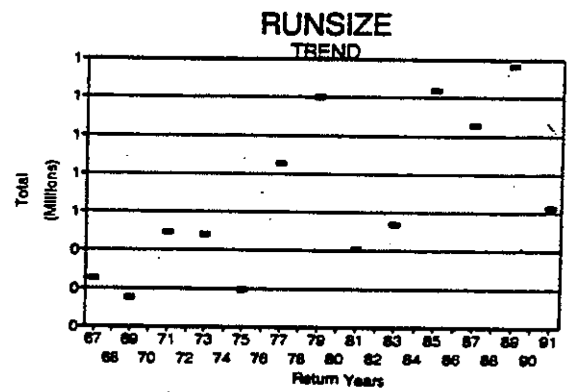
STOCK ASSESSMENT

DATA QUALITY------> NOT AVAILABLE

Return Years	ESCAPE Total	RUNSIZE Total	RUNSIZE Inside
67	100000	253035	159969
68			
69	100000	153309	111839
70			
71	300000	496499	380467
72			
73	250000	482577	338817
74			
75	100000	196430	140546
76			
77	500000	856057	516887
78			
79	300000	1203330	615383
80			
81	100000	411481	233392
82			
83	470000	537723	478036
84			
85	710000	1237325	934180
86			
87	592000	1055143	943298
88			
89	401300	1363589	976330
90			
91	350000	625909	495720

Odd-year returns only.





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution, Genetics

STOCK STATUS

Healthy

SCREENING CRITERIA

OVERVIEW -- SKAGIT SOCKEYE STOCK

BAKER

STOCK DEFINITION AND ORIGIN

The only known sustaining population of sockeye salmon in the Skagit River drainage is found in the Baker River system upstream of upper Baker Dam. Spawning is now confined to artificial spawning beaches. Some of the fry are allowed to rear naturally in Baker Lake. Others are trapped when they emerge and are reared in floating net pens. Both groups spend one year rearing in the lake and smolt during their second year. The smolts must pass through a passage chute at the dam in order to bypass the dam and migrate to the ocean. Most Baker sockeye return as four-year-olds with some three- and five-year-old adults also present. In addition, there are resident populations of kokanee, landlocked sockeye, in Baker Lake and Shannon (lower Baker) Lake that may spawn naturally. Offspring from these spawners could contribute to sockeye returns.

Prior to 1925, sockeye had free access to the Baker River system and Baker Lake. The annual return to the lake at that time was estimated to be approximately 20,000 fish (Kemmerick 1945). Lower Baker Dam, which was constructed in 1925, blocked access to the lake. A ladder and "elevating contrivance" was constructed to provide passage. Adults were released above the dam to spawn naturally. Artificial enhancement began in 1896 when the state built a hatchery on Baker Lake. Hatchery enhancement ended in 1933.

Construction of the Upper Baker Dam, completed in 1959, inundated the valley that included the natural Baker Lake and its natural spawning habitat. To mitigate this loss, artificial spawning beds were constructed at the upper end of the new Baker Lake. The beaches were first used in 1957. An additional sockeye spawning beach was built on Sulfur Creek just below Upper Baker Dam in 1990. The entire escapement of adults is now trapped below lower Baker Dam and transported to artificial spawning beaches. No Baker sockeye eggs are currently spawned or reared artificially.

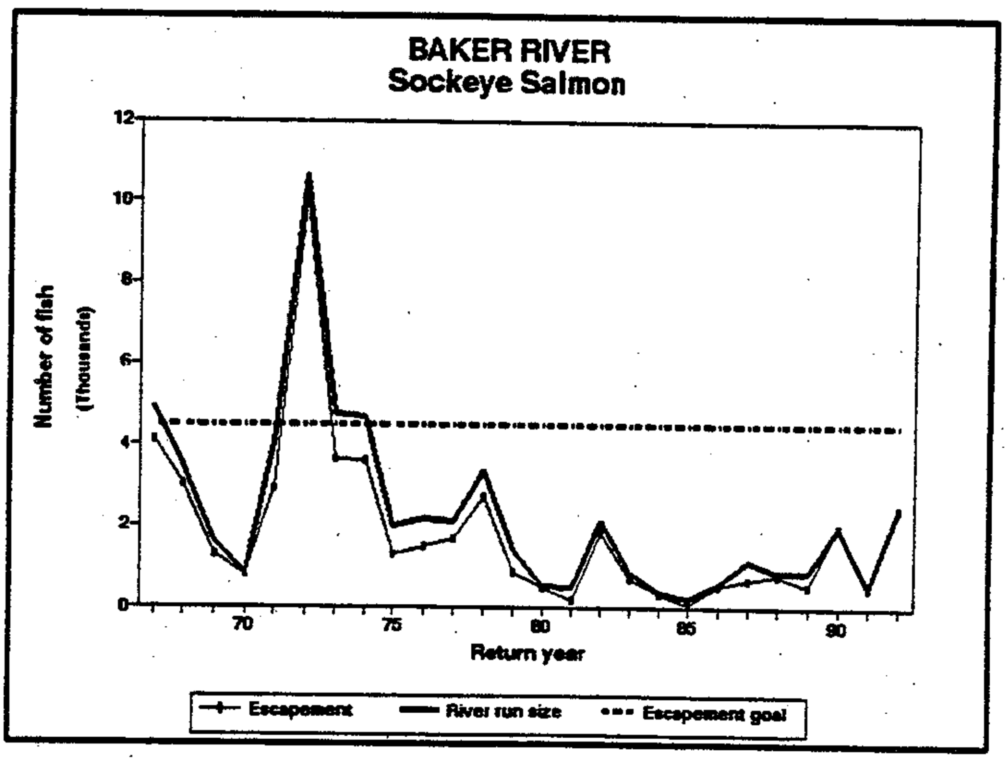
Baker sockeye enter the trap below the lower dam from mid-June to mid-August. Numbers peak in mid-July. Spawning occurs from late September through December, peaking from late October to late November.

This stock is assumed to be of natural origin. Recently, Lake Whatcom kokanee hatchery sockeye have been introduced into Baker Lake. Interbreeding may occur between the sockeye and kokanee populations. Baker sockeye have been exported to other waters of the state including Lake Washington. Thus, the range of sockeye with the same biological characteristics as the Baker fish may extend beyond the Skagit system.

Sockeye are occasionally found in other areas of the Skagit drainage. They are consistently found in very small numbers in the upper Sauk River and the mainstem Skagit near Newhalem. Whether these represent strays from the Baker or other river systems or are small self-sustaining populations of a few individuals is unknown. Scales have been collected to determine life histories but the samples are too few for definite conclusions. For the present, these individuals will not be considered to be a separate stock.

STOCK STATUS

Over the last 25 years, Baker sockeye run-sizes have ranged from a high of 10,672 to a low of 92 in 1985 (see figure). There are no fisheries directed specifically at Baker sockeye although they may be taken incidentally in various mixed stock commercial and sport fisheries. They also offer potential for sport and tribal harvest in the Skagit River if sufficient numbers of sockeye are present to allow a harvest. See the Baker sockeye stock report for additional information.



SKAGIT -- BAKER SOCKEYE

STOCK DEFINITION AND ORIGIN

Baker sockeye are those sockeye that spawn in the Baker River system. Straying may occur to other parts of the Skagit River drainage. These sockeye are believed to be native to Baker Lake and Baker River, a tributary of the Skagit River. They are separated from all other stocks geographically. Baker sockeye have been exported to other waters of the state including Lake Washington.

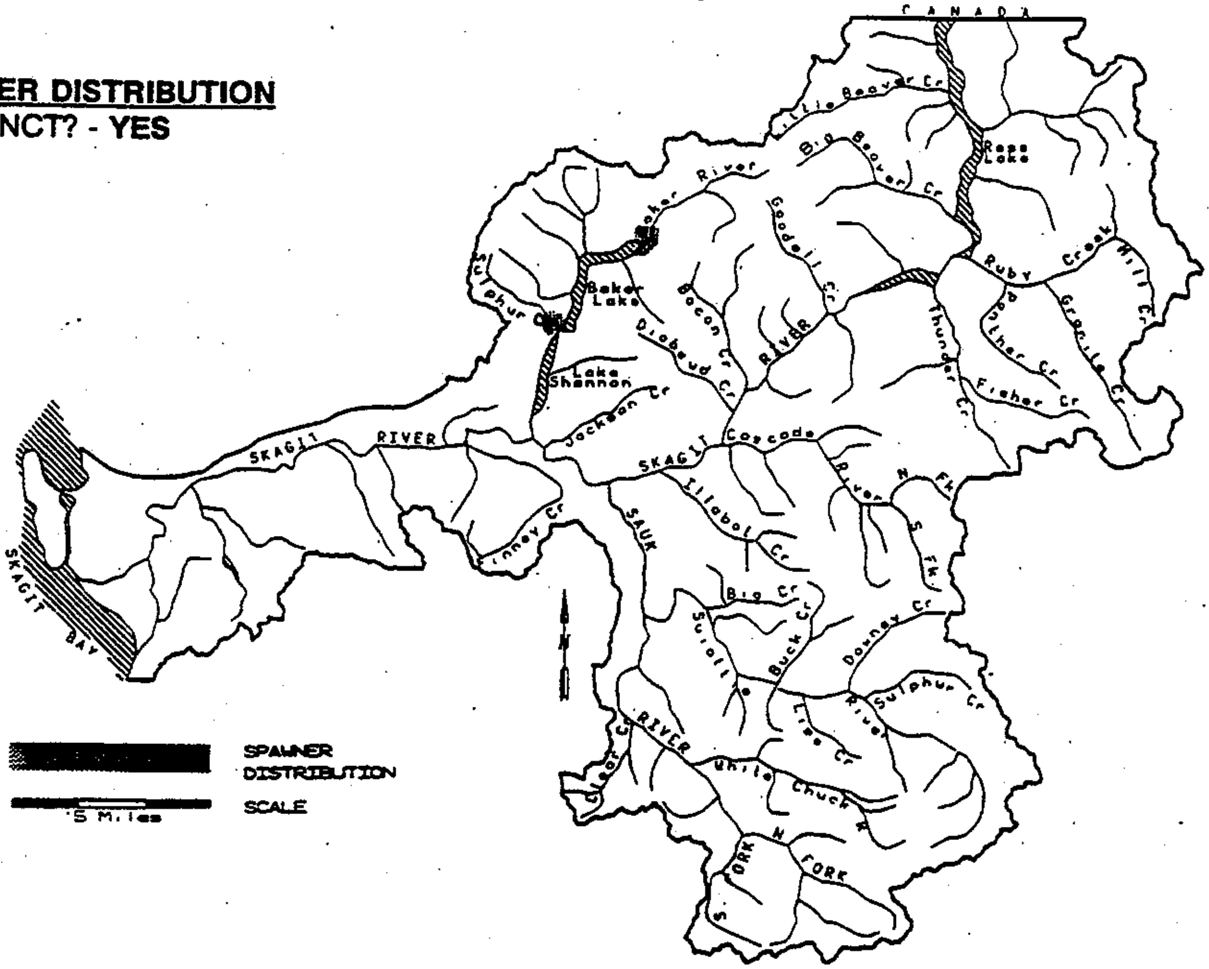
STOCK STATUS

Since data on incidental terminal catches (there are no directed fisheries) may be ambiguous due to misassignment of Fraser sockeye catches to the Skagit terminal area, the best indicator of abundance is the adult trap counts at the Lower Baker Dam. Based on the long-term negative trend in adult trap counts and low smolt return rates, this stock is currently classified as Critical. Recent counts show improvement over some extremely low levels (92 adults in 1985). The increases may be due in part to improvements in the passage of smolts downstream and returns from net pen releases. However, this stock's status is still judged to be Critical because smolt return rates have been highly variable, ranging down to nearly 0% from one brood. The factors that cause low return rates are unknown and if they occur again or if the mechanical dam passage devices on which this stock depends were to fail, the Baker sockeye population could return to near-extinction level.

FACTORS AFFECTING PRODUCTION

Habitat -- The primary habitat limiting factor for Baker sockeye is two hydroelectric dams on Baker River that block adult passage into the lake and juvenile passage out. Adult Baker sockeye are transported around these two dams and placed in artificial spawning beaches adjacent to Baker Lake. Fry are released to rear in the lake. There have been significant egg survival problems at the new spawning beach on Sulfer Creek due to a landslide into the water supply which resulted in heavy sedimentation of the upwelling system installed in the beach. Stabilization of the slide has begun, and it is hoped egg-to-fry survival will improve. Lake productivity for rearing sockeye is a concern, and there may be negative interactions with other rearing salmonids, some of which have been planted. As with Baker coho, outmigrant trapping success at the gulpers is not satisfactory. Gulpers are structures in the forebay of both dams designed to attract and trap smolts so that they can be trucked around the dams or directed into pipelines through the dams. Many smolts are unable to find the gulper and either residualize in the lake, or outmigrate through the turbines and get crushed. Improvements in gulper operations have been attempted in recent years.

STOCK DEFINITION PROFILE for Baker Sockeye



SPAWNER DISTRIBUTION
DISTINCT? - **YES**

TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													NO
RIVER ENTRY													NO
SPAWNING													NO

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - This stock is significantly different from all other Washington stocks [one collection from Baker Lake (N=80); 30-locus G-tests: p<0.001].
[Source of information: NMFS -Seattle]

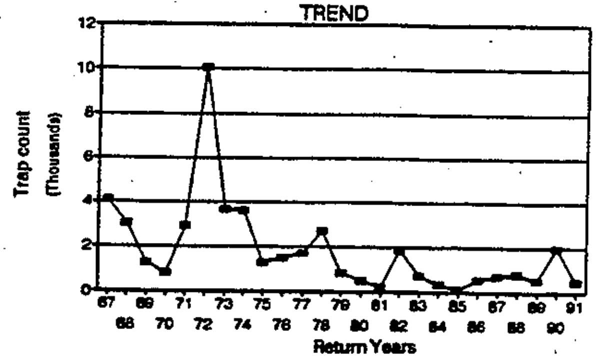
STOCK STATUS PROFILE for Baker Sockeye

STOCK ASSESSMENT

DATA QUALITY-----> Good

Return Years	ESCAPE Trap count			
67	4121			
68	3022			
69	1295			
70	821			
71	2931			
72	10031			
73	3656			
74	3611			
75	1303			
76	1518			
77	1707			
78	2716			
79	865			
80	499			
81	208			
82	1869			
83	735			
84	358			
85	99			
86	542			
87	683			
88	818			
89	536			
90	1976			
91	481			

ESCAPE
TREND



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Cultured

STOCK DISTINCTION
Distribution, Genetics

STOCK STATUS
Critical

SCREENING CRITERIA
Chronically low, LT Neg Trend

Harvest Management -- Baker River sockeye are harvested in Canadian and United States preterminal Fraser Panel fisheries and in Skagit Bay and Skagit River terminal commercial net fisheries. They may also be harvested, as juveniles, in Baker Lake sports fisheries for "silver trout" or kokanee, and as adults in river and lake sports fisheries. In Fraser Panel fisheries, Baker sockeye are believed to be harvested at the rate appropriate for Fraser River sockeye stocks, specifically the early Stuart stocks.

The total Fraser catch of U.S.-origin sockeye is estimated by the Pacific Salmon Commission using scale pattern analysis data collected from test and commercial fisheries; however, this analysis does not break out Baker sockeye specifically. Terminal area impacts are estimated by run reconstruction only. No stock identification methods are yet employed specifically to identify Baker sockeye taken in Fraser fisheries or the terminal area.

Preterminal Fisheries - This stock can be harvested in Canadian Fraser River sockeye fisheries occurring in late July through mid-August. Recent fisheries during this time period have been limited to Strait of Juan de Fuca test fisheries only, due to the desire to limit marine net harvests of commingled early Stuart sockeye stocks.

Catches of Baker sockeye in preterminal fisheries are likely to be low, but numbers are unknown.

Preterminal harvest areas in Washington waters under Fraser Panel management that may impact this stock include the Strait of Juan de Fuca (Areas 4B, 5 and 6C), Port Angeles (Area 6), the San Juan Islands and the Blaine/Cherry Point area (Areas 7 and 7A). U.S. fisheries in these areas during the aforementioned time periods are managed to minimize impacts on Baker River and Lake Washington stocks.

The total Baker sockeye return averaged 0.24% of the Washington sockeye run entering Puget Sound between 1985 and 1989 (from 1992 Sockeye Status Report). The preterminal harvest rate of Baker sockeye in U.S. fisheries is estimated to average 0.5% or four fish per year over this same time period (extrapolated from preterminal catch rates estimated for Lake Washington sockeye).

Terminal Fisheries - No directed terminal commercial net fisheries on Baker sockeye have occurred in recent years due to low stock abundance. The major terminal area commercial net fisheries incidentally impacting this stock include Skagit Bay (Area 8) summer chinook fisheries (mid-June to the end of August) and Skagit River summer chinook fisheries (mid-June to the end of chinook spawning in upper river). Minimum mesh size restrictions are employed to minimize sockeye catches within these chinook-targeted fisheries.

Data on terminal catch may be ambiguous due to misassignment of Fraser sockeye catches to the Skagit terminal area. With obvious misassignments removed (e.g. catches of 100 sockeye by a single fisherman assigned to Area 8), the 1985-1991 harvest of Baker sockeye averaged 73 per year in Skagit Bay and Skagit River terminal fisheries during those time periods. Harvest rates for the Baker run in Skagit Bay and the Skagit River chinook fisheries averaged 12% (range 1% to 30%) over the same time period (data from Microcomputer Historical Catch and Landing Summary database).

Hatchery -- Chinook and coho yearlings are released into the Cascade River from the Skagit Hatchery located near Marblemount. In addition a sockeye net pen rearing program is located on Baker Lake. This program, started in 1985, consists of trapping fry when they emerge from the spawning beaches, rearing them in floating net pens in the lake, and releasing them as smolts below the dams. In addition to sockeye, coho and steelhead are also reared artificially in the Baker system and released below the dams, and catchable-sized trout have been released into the lake. These programs may affect Baker sockeye.

Last ten years salmonid releases into the Baker basin.

Release Year	Coho	Sockeye	Kokanee
1983	91000		
1984	571800		
1985	122466		
1986			
1987	108245	27966	
1988	155379	57300	
1989	105140	57060	
1990	37409	45348	
1991	235098	113367	
1992	313300	107945	256256

OVERVIEW -- SKAGIT SUMMER AND WINTER STEELHEAD STOCKS

SUMMER:	WINTER:
FINNEY CREEK	MAINSTEM SKAGIT / TRIBUTARIES
SAUK	SAUK
CASCADE	CASCADE

STOCK DEFINITION AND ORIGIN

In the Skagit River system, three summer steelhead stocks and three winter steelhead stocks have been identified. Wild summer steelhead in Finney Creek, Sauk River, and Cascade River and wild winter steelhead in mainstem Skagit River and tributaries, Sauk River, and Cascade River are distinct stocks. Summer steelhead in Day Creek may also be a separate stock but are not identified as such in this report. Wild winter steelhead in Baker River were not identified as a separate stock, but it is important to maintain their contribution to production of steelhead in the system. Most of these winter and summer steelhead are native, except the origin of the Cascade summer stock is unknown.

There is little or no information available to indicate that these are genetically distinct stocks. The stocks are treated separately due to the geographical isolation of the spawning populations. There may be more or fewer stocks identified once comprehensive genetic information is available.

Steelhead in the Skagit River system spawn in mainstems and tributaries throughout the anadromous zone from the headwaters downstream as far as Sedro Woolley. Wild steelhead generally spend two or three years in freshwater before outmigrating and spend one, two, or three years in the ocean before returning; about 10% of females return as repeat spawners.

Run-timing of the summer steelhead stocks (May through October) is distinct from run-timing of the winter steelhead stocks (November through April) in the Skagit River system.

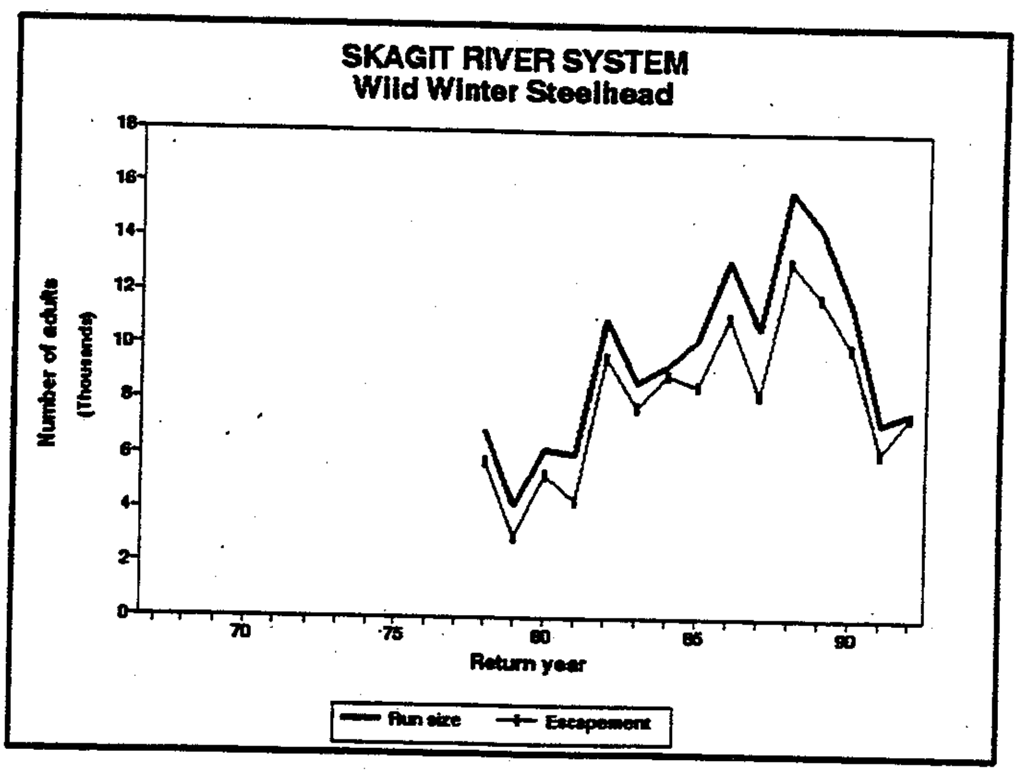
The native summer stocks were historically small runs of fish limited by their habitats. These fish developed in areas isolated from the native winter stocks. Since only a few miles of stream were used, summer steelhead populations were small.

While about 140,000 to 320,000 (mostly 200,000 to 250,000) hatchery winter steelhead smolts are planted in the Skagit River system annually, there is little contribution to the wild stock from hatchery fish spawning in the wild. The returning hatchery adults support tribal and sport fisheries with a combined exploitation rate of about 90%. Given the high exploitation of the hatchery fish, healthy wild spawner escapements, and the difference in spawn-timing between the hatchery fish (January and February) and the wild fish (mid-February through May), the potential for interbreeding is limited.

About 20,000 hatchery summer steelhead smolts are stocked in the Skagit River system annually. The potential for interbreeding between hatchery fish and wild fish certainly exists, but the contribution to the wild stock by hatchery fish spawning in the wild is unknown. Management strategies are presently being reviewed to reduce potential interbreeding.

STOCK STATUS

Wild winter steelhead spawner escapement and run-size have been monitored for the Skagit River system since the 1977-78 season. Wild escapement has ranged from 2,982 to 13,194 fish and wild run-size has ranged from 4,123 to 15,813 fish (see figure).



Escapement goals for wild steelhead in the Skagit system were first set in 1980-81. It is fully expected that actual escapement will fluctuate around the targeted escapement goal due to the fluctuating nature of steelhead runs and varying environmental conditions. These goals have been based on utilization of spawning and rearing area, historical escapement levels, and judgments of biologists conducting spawning surveys on the Skagit River (WDW 1992).

For the 1980-81 season, the escapement goal for wild steelhead was 7,000. For 1981-82 and 1982-83, the goal was 8,000 for each year. In 1983-84, it was decided to allow 10% incidental harvest of the wild run while harvesting the hatchery steelhead in the system. For the 1984-85 season through the 1990-91 season, it was agreed to harvest 2,500 wild steelhead each year while the wild run sizes fluctuated. For the 1991-92 and 1992-93 seasons, the state and tribes agreed to fish a fixed fishing schedule.

Spawning escapement of wild winter-run steelhead in the Skagit basin has, at times, been below the level necessary to achieve full productive capacity as determined by environmental conditions and habitat quality (Woodin et al. 1984, Phillips et al. 1981). Spawning escapements of wild winter-run steelhead from 1978 to 1991 ranged from a low of 2,982 in 1978-79 to a high of 13,194 in 1987-88. The average wild escapement for the 15 year period was 8,093 (see table).

The current WDW escapement goal of 10,300 wild winter-run steelhead was established in 1984-85 for the Skagit River. This goal is to be achieved by wild adults and does not include hatchery fish spawning in the wild. The WDW recognizes that there are other methods available to establish an escapement goal for the Skagit system. The WDW method (Gibbons et al. 1985) is based on the rearing potential of the system and a standardized stock-recruitment relationship. The Skagit System Cooperative goal is derived by analyzing the number of returning adults from a known escapement and this analysis estimates that maximum sustainable harvest escapement has been in the range of 3,000 to 6,500 wild steelhead. The parties continue to collect data and work toward agreeing to an escapement goal.

The wild winter steelhead run in the Skagit River system is fished upon by the Swinomish Tribe in the lower Skagit mainstem and Skagit Bay and by the Upper Skagit Tribe and Sauk-Suiattle Tribe in the lower mainstem Skagit. Sport anglers fish in the mainstems of the Skagit and Sauk rivers as well as in major tributaries such as the Cascade, Suiattle, and Whitechuck rivers. The targeted tribal fishery occurs primarily during December, January, and February upriver and through mid-March in the lower river. The sport fishery occurs from November through March on the mainstems and through February on the main tributaries. There is also a catch-and-release sport fishery on the upper Skagit and Sauk River during March and April. In

1977, when low escapements of wild steelhead in the Skagit River were suspected, new sport fishing restrictions were initiated (DeShazo 1985). Since 1993, wild steelhead release regulations have been in effect in all marine areas.

During the 1977-78 through 1991-92 return years, the wild winter steelhead run in the Skagit River system was comprised of 10.9% sport harvest, 4.5% tribal harvest and 84.6% escapement (see table). Sport and tribal harvest combined ranged from about 100 to 2,600 wild steelhead with no clear trend, although harvest was well under the average during the 1990-91 and 1991-92 seasons.

Skagit River system wild winter steelhead sport harvest, tribal harvest, spawner escapement, and run-size from 1977-78 through 1991-92.

Return year	Sport harvest	Tribal harvest	Spawner escapement	Run-size
1977-78	371	787	5,757	6,915
1978-79	240	901	2,982	4,123
1979-80	799	154	5,288	6,241
1980-81	1,105	623	4,308	6,036
1981-82	1,023	384	9,609	11,016
1982-83	666	281	7,732	8,679
1983-84	296	79	8,963	9,338
1984-85	1,435	283	8,603	10,321
1985-86	1,916	233	11,098	13,247
1986-87	1,895	535	8,305	10,735
1987-88	1,873	746	13,194	15,813
1988-89	1,905	676	11,854	14,435
1989-90	1,351	272	10,017	11,640
1990-91	637	465	6,174	7,276
1991-92	53	84	7,514	7,651
Mean run-size distribution, 1977-78 to 1991-92				
	1,038	434	8,093	9,565
	10.9%	4.5%	84.6%	

Wild summer steelhead spawning escapement in the Skagit basin is not monitored and escapement goals have not been identified. There are no tribal fisheries that target Skagit River system summer steelhead, but they may be caught incidentally in other tribal salmon and steelhead fisheries. These stocks have been managed with wild steelhead release regulations to protect the wild stocks from sport harvest in freshwater areas since 1992 and in all marine areas since 1993. It is expected that with current regulations in place these stocks will reach population levels dictated by their limited habitats. Because of the small population sizes and limited habitats used, wild summer steelhead populations will always be fragile.

More information on each stock is presented in separate Stock Reports.

SKAGIT -- FINNEY CREEK SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in Finney Creek are a distinct stock based on the geographical isolation of the spawning population. They are distinct from wild winter steelhead in Finney Creek based on run-timing.

The specific spawning distribution is unknown, but spawning is generally believed to take place in the upper reaches of the river. This would geographically separate summer steelhead spawning in Finney Creek from other summer steelhead stocks in the Skagit River system by about 40 miles. Run-timing is unknown but believed to be from May through October and spawn-timing is also unknown but believed to be from February through April.

Little is known about the genetic composition of the stock. There has been some electrophoretic analysis of steelhead fry from Finney Creek (Campton 1980) which indicated that allele frequencies of steelhead collected in Finney Creek differed significantly from those collected elsewhere in the Skagit.

Wild summer steelhead are believed to be native in Finney Creek.

STOCK STATUS

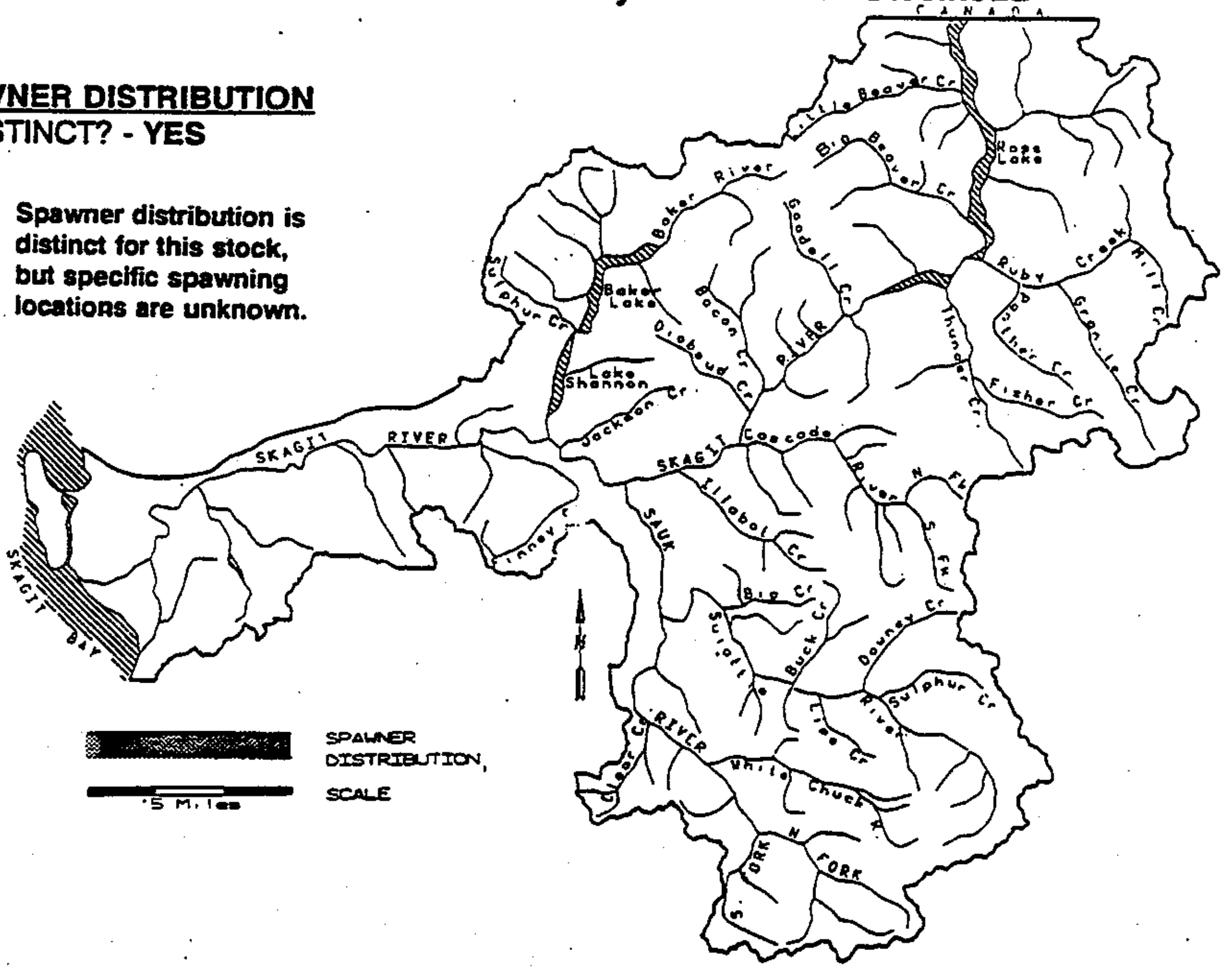
The status of the stock is Unknown. This stock is comprised of a historically small number of steelhead, but there is insufficient information to classify its status as either a Healthy, Depressed, or Critical stock.

Spawning escapement is not monitored for this stock nor has an escapement goal been identified.

Sport harvest is available for many years but wild summer steelhead were not reported separately on steelhead permit cards until the 1986 summer steelhead season. Sport harvest of wild summer steelhead is available over the entire run, but wild sport harvest is too low to be used to assess the status of the wild stock.

More information needs to be collected on this stock so that stock status can be determined. As a small stock, it could be especially vulnerable to any negative impacts.

STOCK DEFINITION PROFILE for Finney Cr Summer Steelhead



SPAWNER DISTRIBUTION
DISTINCT? - **YES**

Spawner distribution is distinct for this stock, but specific spawning locations are unknown.

TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													**UNK**
SPAWNING													**UNK**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Finney Cr Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Poor

Return Years	NO DATA			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

FACTORS AFFECTING PRODUCTION

Habitat -- Spawning and rearing habitat in Finney Creek has been degraded due to forest practices and land slides, but quantitative data are limited.

Harvest Management -- There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. This stock has been managed with wild steelhead release regulations to protect the wild stock from sport harvest since 1991, but some hook-and-release mortality may occur.

Hatchery -- While hatchery steelhead smolts have been stocked in nearby streams, contribution to the wild stock from hatchery fish spawning in the wild is unknown.

SKAGIT -- SAUK SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in the Sauk River are native and a distinct stock based on the geographical isolation of the spawning population. Wild summer steelhead are found in the Sauk basin in only its forks and possibly the mainstem Sauk immediately downstream from the forks. This stock is separated by more than 50 river miles from other Skagit summer stocks.

Run-timing is generally from July through mid-October and spawn-timing is generally from early to mid-April through May for wild summer steelhead in this stock. The population is also typical in that most adults return to their rivers after only one year at sea.

STOCK STATUS

The status of the stock is Unknown.

This stock has always been limited in numbers due to the amount of habitat and competition with wild winter steelhead. Current numbers of fish in the population are probably stable. Observations since 1980 indicate that current abundance may be similar to that of 1980 when the stock was in an essentially unfished state, however these observations have not been documented or verified. The stock is considered to be fragile due to its natural low population level.

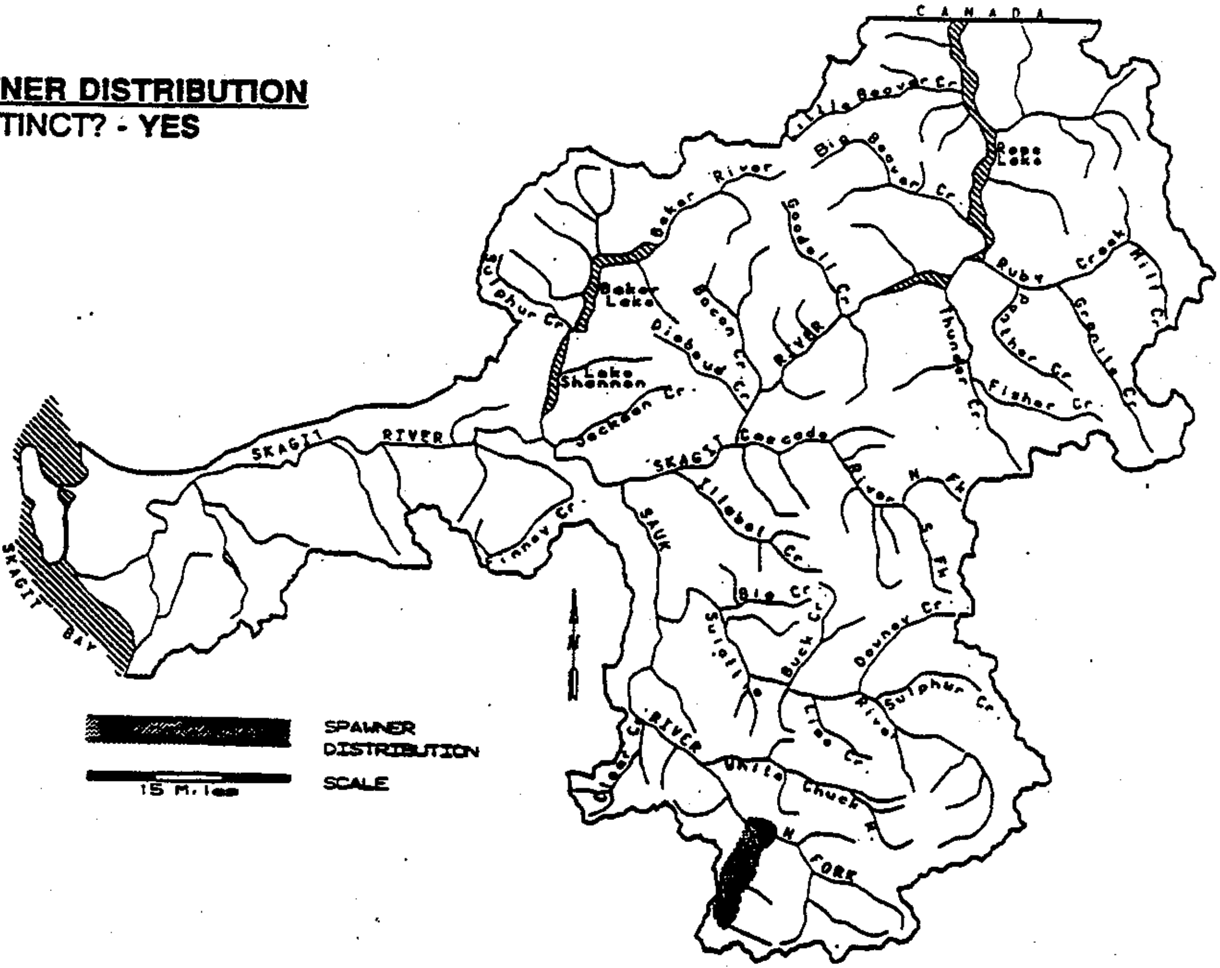
FACTORS AFFECTING PRODUCTION

Habitat -- Other than a large slide near the mouth of the South Fork of the Sauk, the available habitat is in good shape and is not limiting summer steelhead production.

Harvest Management -- Wild steelhead release sport regulations have protected this stock from sport harvest since 1988, but some hook-and-release mortality may occur. There may be some incidental harvest due to poaching and incidental harvest during commercial salmon seasons in the Skagit River or nearby marine waters.

Hatchery -- The Sauk is not normally planted with summer steelhead. An occasional hatchery summer is sampled in the upper Sauk basin that has strayed from elsewhere. While these strays are present during the summer, most of them disappear during the fall. Interactions between hatchery and wild summer steelhead are minimal.

STOCK DEFINITION PROFILE for Sauk Summer Steelhead



SPAWNER DISTRIBUTION
DISTINCT? - YES

TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY							▬	▬	▬	▬			NO
SPAWNING				▬	▬								NO

BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Sauk Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY----> Fair

Return Years	HARVEST Sport			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86	33			
87	26			
88				
89				
90				
91				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

SKAGIT -- CASCADE SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in the Cascade River and its forks are a distinct stock based on the geographical isolation of the spawning population. They are distinct from wild winter steelhead in the Cascade River based on run-timing.

The specific spawning distribution is unknown, but spawning is generally believed to take place in the upper reaches of the river. This would geographically separate the summer steelhead spawning in the Cascade River from other summer steelhead stocks in the Skagit River system by about 40 miles.

Little is known about the genetic composition of the stock. There has been some electrophoretic analysis of steelhead fry from the Cascade River (Campton 1980) which indicated that allele frequencies of steelhead collected in the Cascade River differed significantly from those collected elsewhere in the Skagit River system.

Similar to other wild summer steelhead stocks, run-timing is generally from May through October and spawn-timing is generally from mid-January through April.

While native summer steelhead historically returned to the Cascade River, present stock origin is unknown due to the uncertainty about the amount of contribution by hatchery fish spawning in the wild.

STOCK STATUS

The status of the stock is Unknown. This stock is comprised of a historically small number of steelhead, but there is insufficient information to classify its status as either a Healthy, Depressed, or Critical stock.

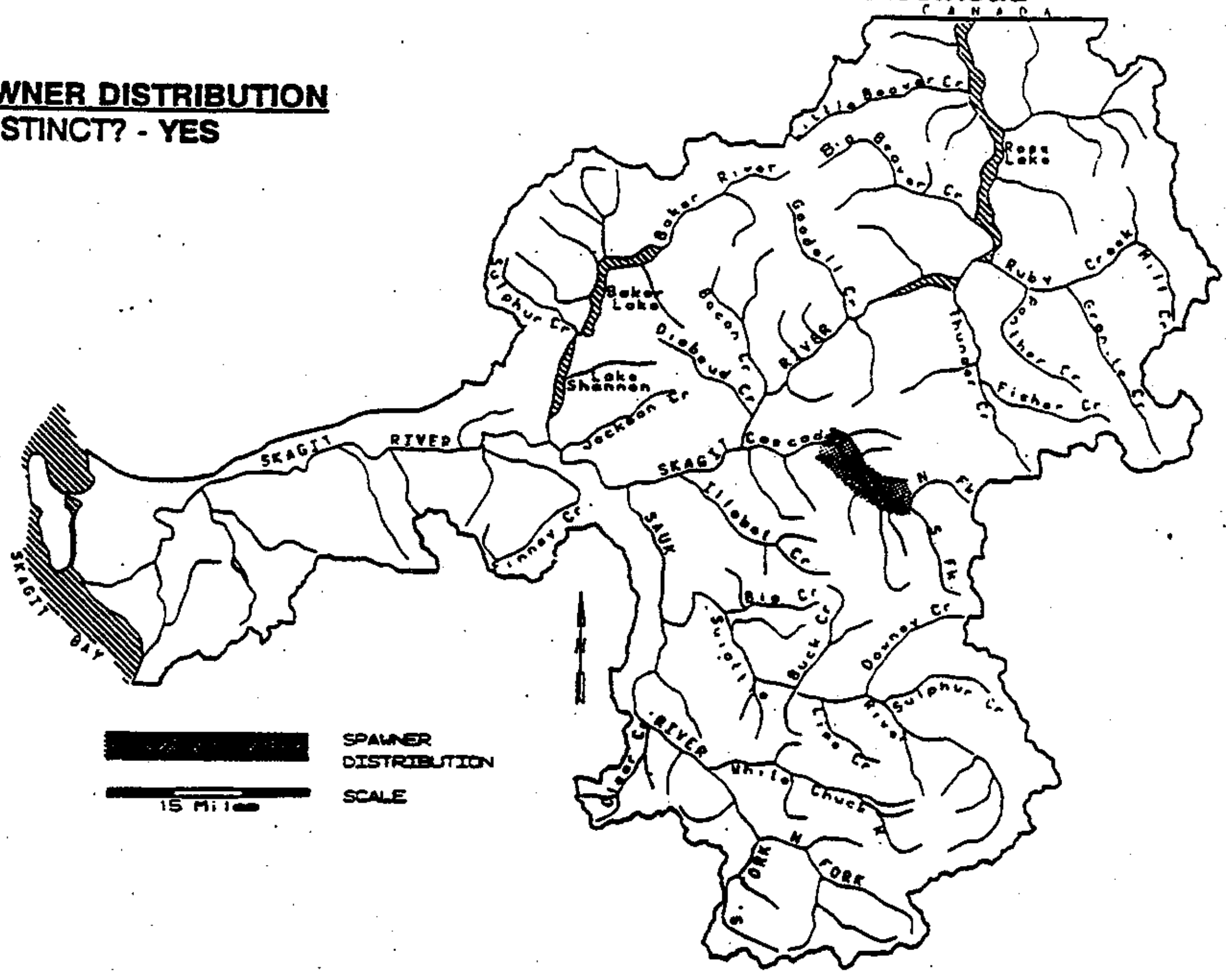
Spawning escapement is not monitored for this stock nor has an escapement goal been identified.

Sport harvest data are available for many years but wild summer steelhead were not reported separately on steelhead permit cards until the 1986 summer steelhead season. Sport harvest data of wild summer steelhead are available over the entire run, but wild sport harvest is too low to be used to assess the status of the wild stock.

More information needs to be collected on this stock so that stock status can be determined. As a small stock, it could be especially vulnerable to any negative impacts.

STOCK DEFINITION PROFILE for Cascade Summer Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													NO
SPAWNING													NO

BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

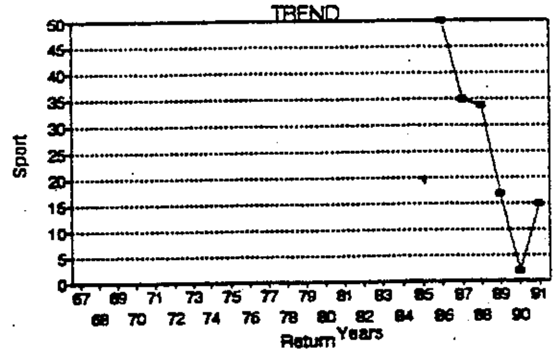
STOCK STATUS PROFILE for Cascade Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY-----> Fair

Return Years	HARVEST Sport			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86	50			
87	35			
88	34			
89	17			
90	2			
91	15			

HARVEST



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Unknown

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Spawning Distribution

STOCK STATUS

Unknown

SCREENING CRITERIA

FACTORS AFFECTING PRODUCTION

Habitat -- Freshwater habitat has been impacted by land use (forest management) activities, but quantitative data are limited.

Harvest Management -- There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. This stock has been managed with wild steelhead release regulations to protect the wild stock from sport harvest since 1992, but some hook-and-release mortality may occur. Difficult access to the Cascade River also limits sport harvest.

Hatchery -- While hatchery steelhead smolts have been stocked, contribution to the wild stock from hatchery fish spawning in the wild is unknown.

SKAGIT -- MAINSTEM SKAGIT / TRIBUTARIES
WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the mainstem Skagit River and all its tributaries (including the Baker River) except for the Sauk River and Cascade River are native and a distinct stock based on the geographical isolation of the spawning population. They differ from Sauk winter steelhead by having a somewhat later spawn-timing in the lower mainstem Skagit, but the upper mainstem Skagit steelhead have essentially the same spawn-timing as Sauk winter steelhead. They spawn in a different location from Sauk and Cascade winter steelhead, but there is no break in spawning between the mainstem Skagit stock and the other two winter stocks.

Little is known about the genetic composition of the stock. There has been some electrophoretic analysis of steelhead fry (Campton 1980) which indicated that allele frequencies of steelhead collected from some Skagit River tributaries differed significantly from those collected elsewhere in the Skagit.

Similar to other wild winter steelhead stocks in the Skagit River system, run-timing is generally from November through April and spawn-timing is generally from early March to late May or June.

Hatchery steelhead smolts have been stocked, but there is little contribution to the wild stock from hatchery fish spawning in the wild due to the differences in spawn-timing of hatchery and wild steelhead.

STOCK STATUS

The wild winter steelhead stock is Healthy.

Stock status is based upon wild steelhead spawner escapement.

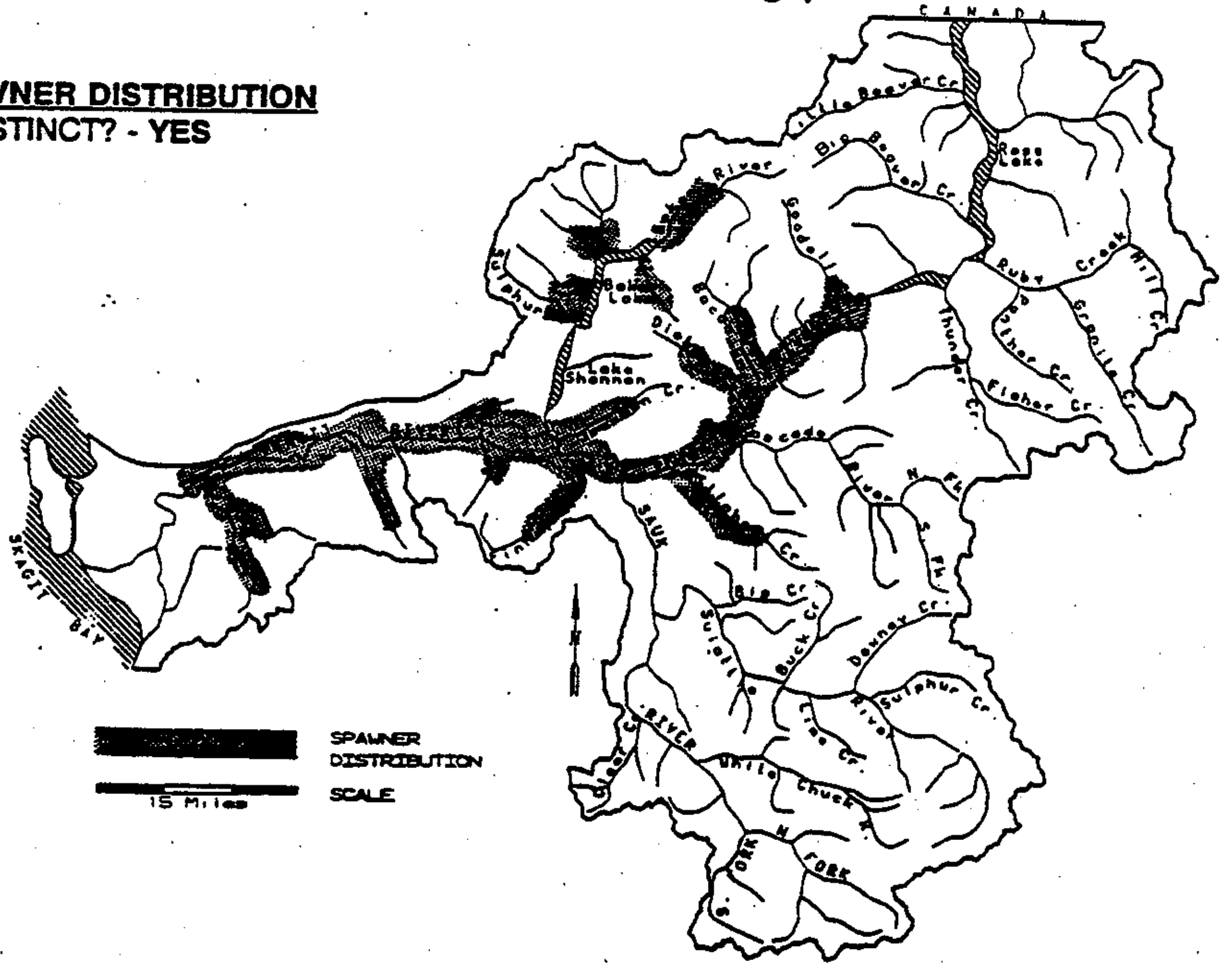
Spawner escapement ranged from about 5,000 to 7,000 wild steelhead during the 1982 through 1985 seasons and from about 2,500 to 8,000 wild steelhead during the 1986 through 1992 seasons. The short term decline in escapement during 1991 and 1992 is primarily due to recent changes in ocean survival and impacts of 1986 and 1987 droughts.

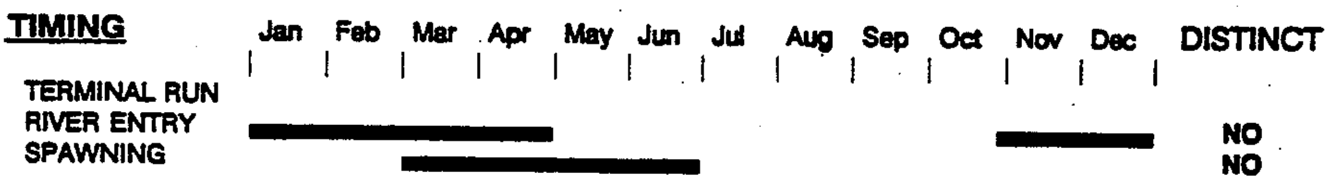
A recent Washington Department of Wildlife study (Cooper and Johnson 1992) concluded that there have been long-term fluctuations and recent declines in winter, summer, hatchery and wild steelhead abundance and survival in the Puget Sound, Strait of Juan de Fuca, Pacific coast and Columbia River areas in Washington. There were also similarities in the overall trends and year-to-year trends of steelhead

STOCK DEFINITION PROFILE for Mainstem Skagit/Tribs Winter Steelhead

SPAWNER DISTRIBUTION

DISTINCT? - **YES**





BIOLOGICAL CHARACTERISTICS

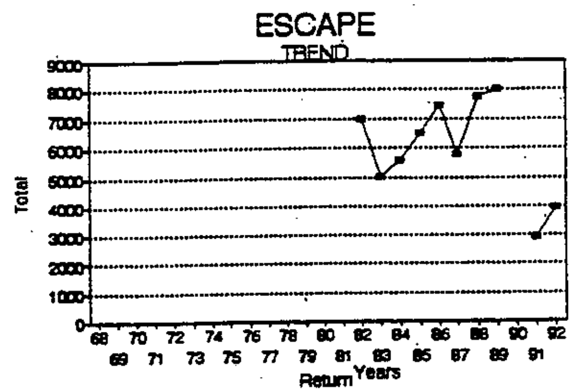
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Mainstem Skagit/Tribs Winter Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82	6988			
83	5018			
84	5556			
85	6506			
86	7463			
87	5802			
88	7762			
89	8042			
90				
91	2934			
92	3920			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Spawning Distribution

STOCK STATUS

Healthy

SCREENING CRITERIA

abundance in Washington, British Columbia and Oregon. Similarities in survival trends over widespread geographic areas indicate that common factor(s) to each of these areas are responsible for recent changes in steelhead survival. A combination of factors contributed to the recent decline in steelhead abundance including low ocean productivity, competition for food in the ocean, and catch of steelhead in authorized and unauthorized high seas drift net fisheries.

In addition, the Skagit mainstem and tributaries downstream from the mouth of the Sauk River were damaged by the 1982-83 flood event that blew out most tributaries and deposited loose, uncompacted gravel and sand in alluvial fans across lowland farm land. During the drought years of 1986 and 1987, most water in these areas went underground and stranded fish. Since approximately one-half of lower mainstem spawning is in the tributaries, it is not difficult to attribute, in part, the spawner escapement declines in 1991 and 1992 to this habitat destruction. Recovery of these streams will take at least until 1997 if we experience normal precipitation and other weather related factors. We can expect drought conditions, which returned in 1992, to continue to impact fish survival due to reduced snowpack in the North Cascades. This will limit discharge rates through Ross Dam which will limit mainstem juvenile survival and may lead to dewatering of some redds.

The reduction in returning steelhead adults to this system could result in a relatively long recovery period.

We are concerned about the status of this stock, due to the recent low escapements and habitat degradation. This stock will be closely monitored and will be reclassified if warranted.

SKAGIT -- SAUK WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the Sauk, Suiattle, and Whitechuck rivers and their tributaries and forks are a distinct stock based on the geographical isolation of the spawning population. Run-timing is generally from January through May. This stock has a later spawning time than most Puget Sound winter steelhead with peak spawning occurring in mid-May and continuing through July. This stock has a high percentage (45 percent) of adults which spend three years in saltwater and attain a large average size. An occasional older fish is found in the population with some fish having spent as much as five rearing seasons at sea before returning to spawn the first time. Fish may weigh in excess of 30 pounds. Spawning takes place throughout the basin with the peak activity occurring between river miles 13.5 and 21.

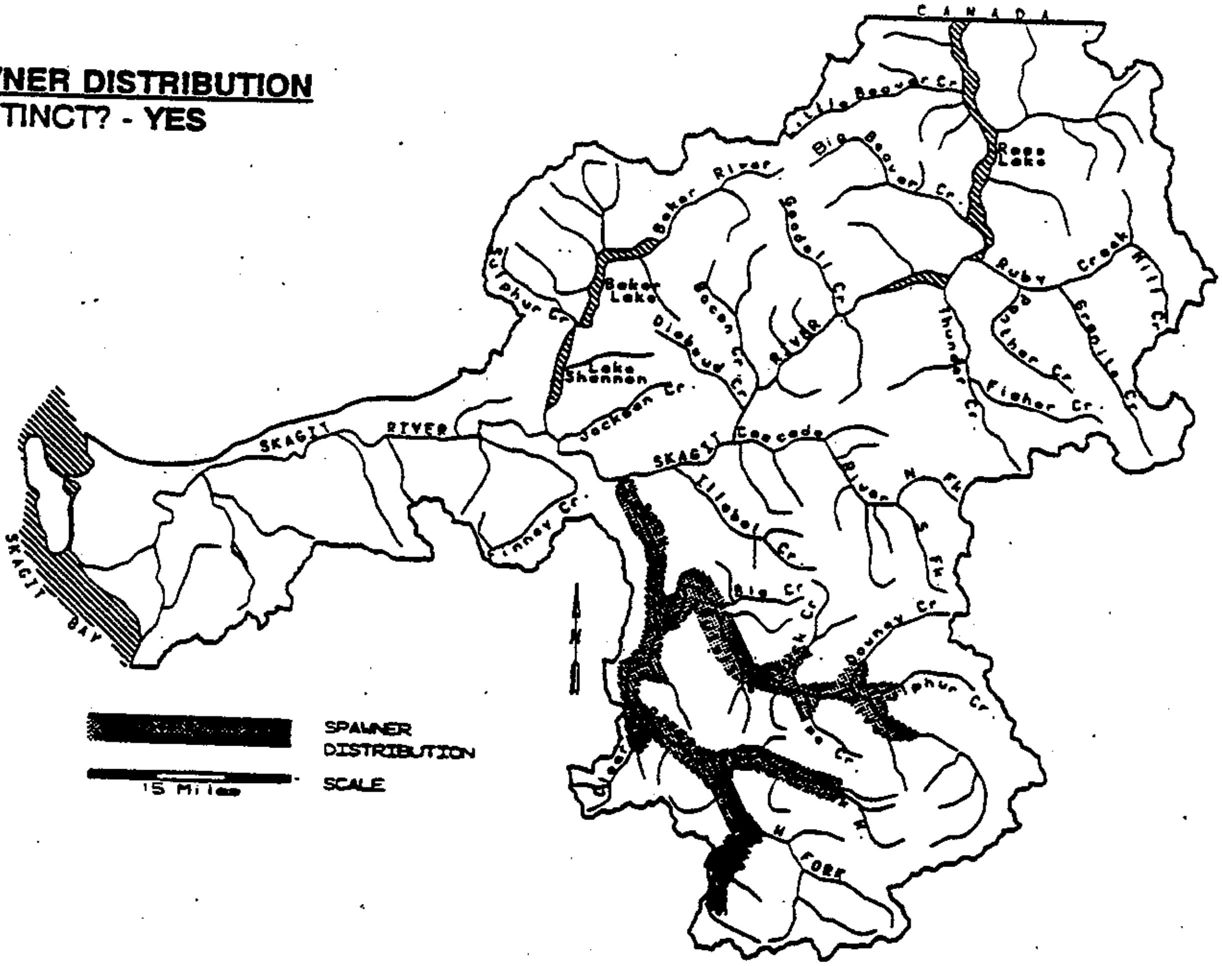
This stock is of native origin and has little interaction with hatchery stocks. The domestic hatchery winter stock spawns much earlier than the native stock. There was a short term enhancement effort using wild fish as brood stock. It is believed that the resulting adults from this program were limited and contributed little to the population.

STOCK STATUS

The status of the stock is Healthy.

The population was at low levels in the late 1970s with wild escapements of about 700 wild steelhead, but has since rebounded. Spawner escapements have ranged from 1,906 to 4,740 wild steelhead between 1982 and 1991.

STOCK DEFINITION PROFILE for Sauk Winter Steelhead



SPAWNER DISTRIBUTION
DISTINCT? - YES

TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													NO
SPAWNING													NO

BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

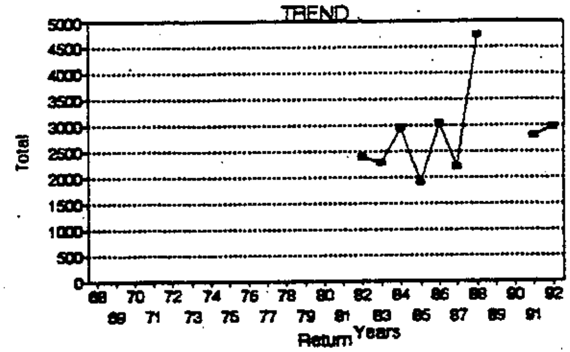
STOCK STATUS PROFILE for Sauk Winter Steelhead

STOCK ASSESSMENT

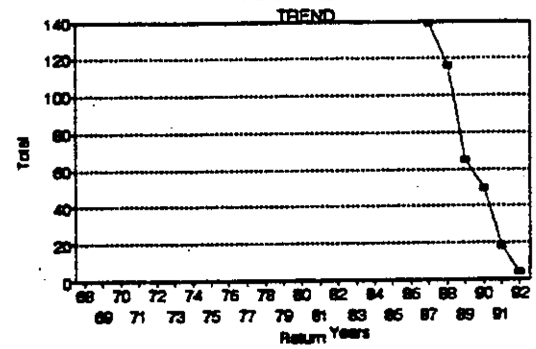
DATA QUALITY------> Good

Return Years	ESCAPE Total	HARVEST Total		
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82	2405			
83	2296			
84	2945			
85	1906			
86	3047			
87	2225	139		
88	4740	116		
89		65		
90		50		
91	2818	18		
92	2982	4		

ESCAPE



HARVEST



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Healthy

SCREENING CRITERIA

SKAGIT -- CASCADE WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the Cascade River are a distinct stock based on the geographical isolation of the spawning population. There is, however, no break or discontinuity between spawning areas in the Cascade and spawning areas in the mainstem Skagit River. Although unknown, run-timing (November through April) and spawn-timing (early March through June) are believed to be similar to other wild winter steelhead stocks in the Puget Sound region.

Little is known about the genetic composition of the stock. While electrophoretic analysis of steelhead fry (Campton 1980) indicates steelhead in the Cascade River have different allele frequencies from those steelhead collected in other areas, it may be due to presence of both winter and summer steelhead or hatchery fish progeny in the samples.

STOCK STATUS

The status of the stock is Unknown. This stock is comprised of a historically small number of steelhead, but there is insufficient information to classify its status as either a Healthy, Depressed, or Critical stock.

Spawning escapement is not monitored for this stock nor has an escapement goal been identified.

Sport harvest is available for many years but wild winter steelhead were not reported separately on steelhead permit cards until the 1986-87 winter steelhead season. Sport harvest of wild winter steelhead is available for only the early portion of the run because the sport steelhead season closes on February 28. As a result, sport harvest cannot be used to assess the status of the wild stock.

More information needs to be collected on this stock so that stock status can be determined. As a small stock, it could be especially vulnerable to any negative impacts.

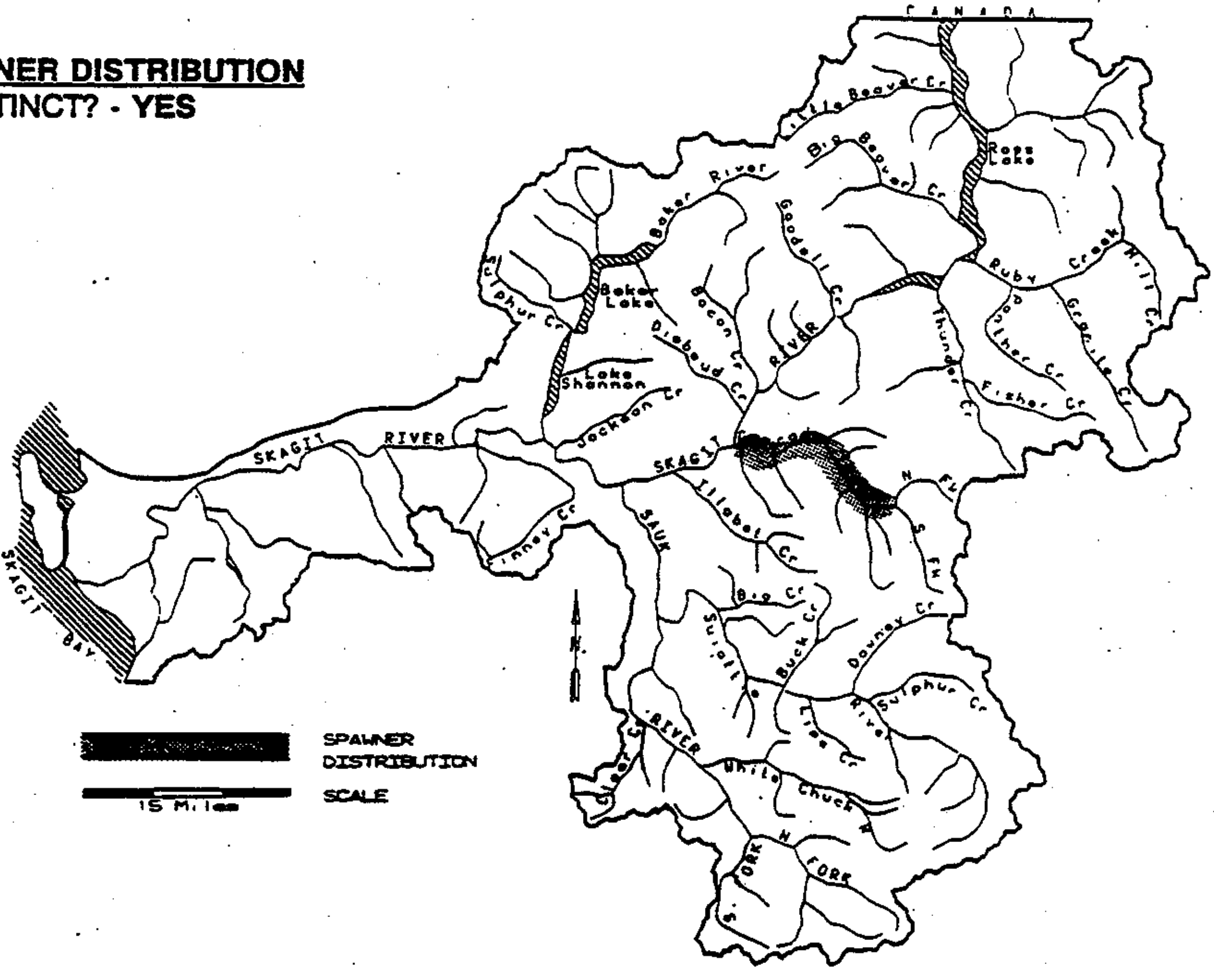
FACTORS AFFECTING PRODUCTION

Habitat -- Freshwater habitat has been impacted by land use (forest management) activities, although quantitative data are limited.

Harvest Management -- There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries. The sport fishery closes on March 1 before the majority of the wild stock enters the stream. Difficult access to the Cascade River also limits sport harvest.

STOCK DEFINITION PROFILE for Cascade Winter Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													UNK
SPAWNING													UNK

BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Cascade Winter Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Fair

Return Years	HARVEST Sport			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87	6			
88	18			
89	8			
90	3			
91	3			
92	5			

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

Hatchery -- While hatchery winter steelhead smolts have been stocked in the mainstem Skagit, contribution to the wild stock from hatchery fish spawning in the wild is unknown.

OVERVIEW -- STILLAGUAMISH CHINOOK STOCKS

STILLAGUAMISH SUMMER
STILLAGUAMISH FALL

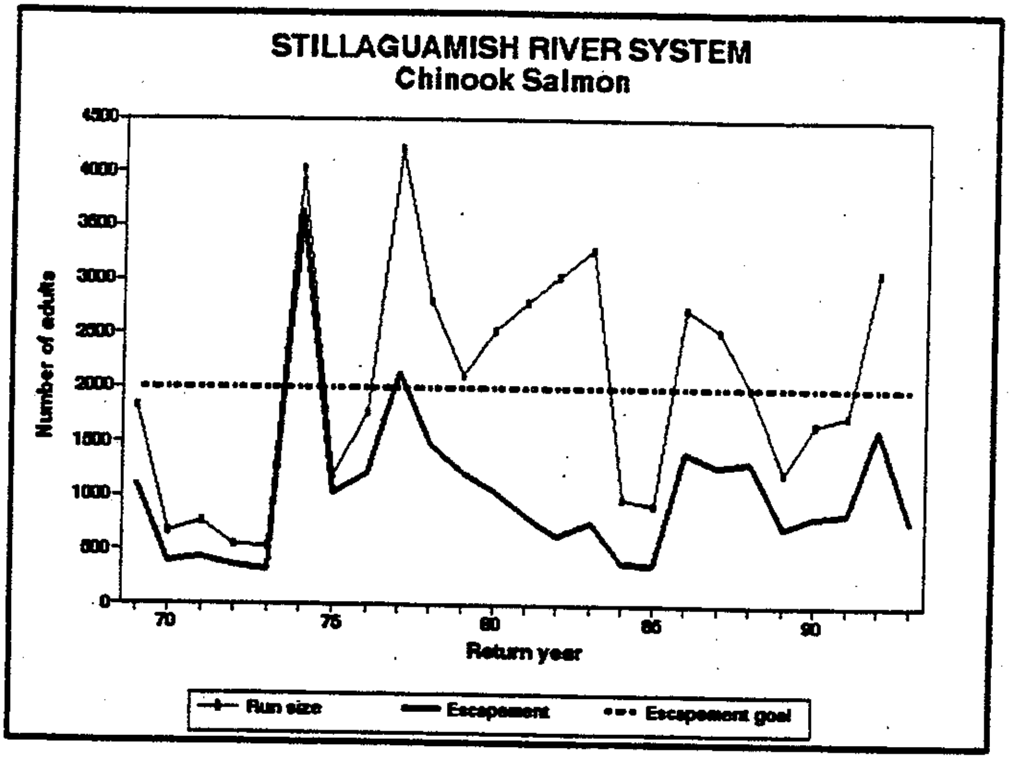
STOCK DEFINITION AND ORIGIN

Stillaguamish chinook have been divided into two different stocks: Stillaguamish summer chinook and Stillaguamish fall chinook. This division was based upon spawn timing differences and less distinct differences in geographical distribution of spawning. The genetic baseline for the summer stock has been developed and indicates that this stock is unique when compared to other Puget Sound stocks. However a baseline has not yet been developed for the Stillaguamish fall stock.

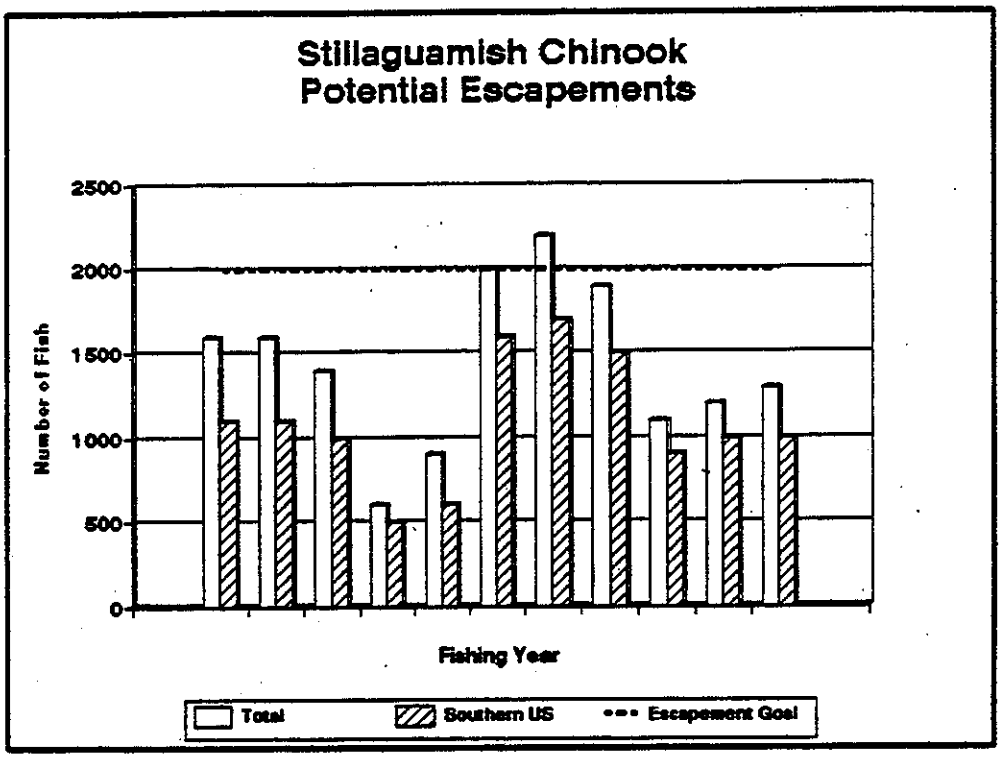
The summer stock spawns in September in the North Fork Stillaguamish while the fall stock spawns primarily in October throughout the mainstem and South Fork. Potential geographical overlap in spawning distribution exists in the mainstem Stillaguamish, but significant genetic separation seems likely considering the difference in spawn timing and the partial geographic separation.

STOCK STATUS

Puget Sound potential escapement estimates have been variable with no apparent trend. The escapement goal for Stillaguamish chinook of 2,000 spawners per year has been attained in only two years since 1968. There appear to be cycles of very low escapements (<800) followed by a series of years with escapement above 1,100 fish per year (see figure).



The two Stillaguamish chinook stocks are managed as a single unit. The second figure (Puget Sound Salmon Stock Review Group, 1992) shows Stillaguamish chinook potential escapements assuming no fisheries on this run in Alaska and Canada (solid bars) or in the lower 48 states.



Stillaguamish chinook potential escapements assuming no fisheries on this run in Alaska and Canada (solid bars) and no fisheries in the U.S. lower forty-eight states (hatched bars). The escapement goal is 2,000 adults. From the Puget Sound Salmon Stock Review Group (1992).

Distribution of fishing mortality of Stillaguamish chinook is summarized in the following table (Puget Sound Salmon Stock Review Group, 1992). The greatest impact occurs in Canada. The second greatest impact is due to Puget Sound sport fisheries.

Distribution of adult equivalent fishing mortality for Snohomish summer/fall chinook. From the Puget Sound Salmon Stock Review Group, 1992.

Brood	Alaska All	Canada All	PFMC Spt/Tr	Troll	Puget Sound North Net[4]	Puget Sound Other Net	Sport
1980	2	47	0	0	1	7	26
1981	23	70	0	0	1	7	10
1982	0	135	0	0	11	13	48
1983	14	75	0	0	0	12	30
1986[1]	0	178	0	19	4	32	86
1987[2]	5	300	0	30	9	37	52
1988[3]	0	34	0	0	0	28	3
Total 1980-86	39	505	0	19	17	71	200
Percent	4.6%	59.3%	0.0%	2.2%	2.0%	8.3	23.5

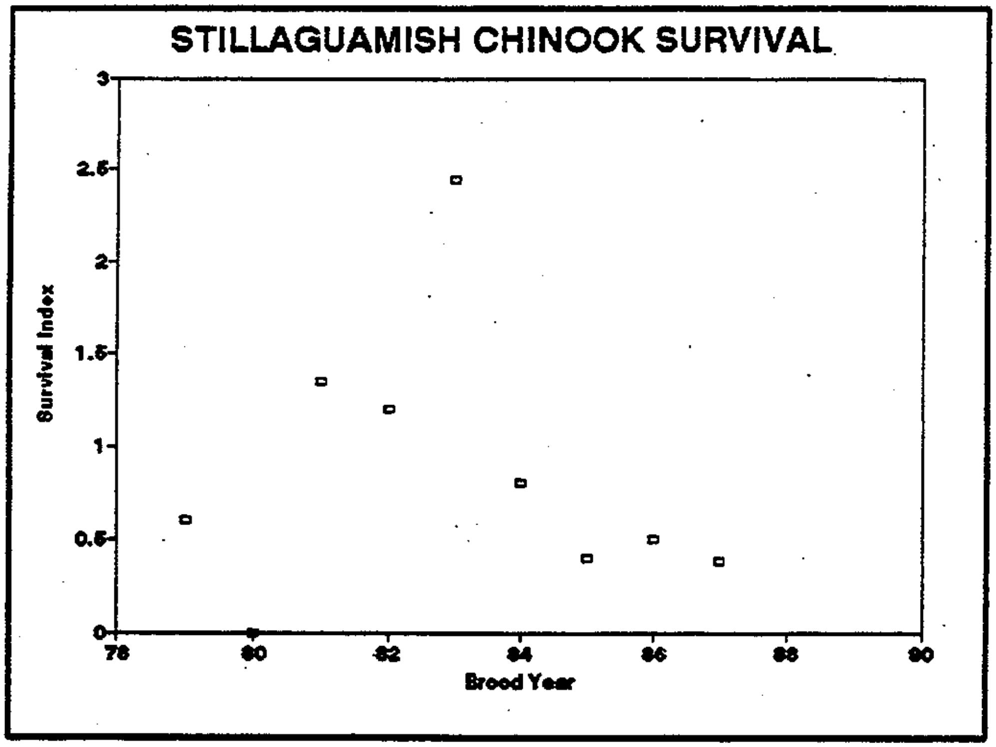
[1] Incomplete brood; ages 2 through 4 included in analysis.

[2] Incomplete brood; ages 2 and 3 included in analysis.

[3] Incomplete brood; age 2 included in the analysis.

[4] North net includes the Strait of Juan de Fuca, the San Juan Islands and the Blaine/Cherry Point area.

Survival of Stillaguamish chinook, based on a complex index devised by the Chinook Technical Committee of the Pacific Salmon Commission (Puget Sound Salmon Stock Review Group, 1992) is shown in the third figure. Survival has decreased since 1983.



Survival of Stillaguamish chinook based on a complex index devised by the Chinook Technical Committee of the Pacific Salmon Commission. The usefulness of the index for SASSI lies in its ability to show trends across time. From the Puget Sound Salmon Stock Review Group (1992).

A supplementation program for Stillaguamish summer chinook has been initiated by the Stillaguamish Tribe. Returns from this program accounted for a significant portion of the 1991 and 1992 escapements (John Drotts, Stillaguamish Tribe, personal communication based on information from the WDF Coded-Wire Tag Recovery Lab).

More information on each stock is presented in separate Stock Reports.

STILLAGUAMISH -- STILLAGUAMISH SUMMER CHINOOK

STOCK DEFINITION AND ORIGIN

Stillaguamish summer chinook spawn in September, and spawning typically peaks in the second week of September. Documented spawning occurs in the North Fork Stillaguamish from RM 0.0 to RM 34.4, however most spawning occurs from RM 14.3 to RM 30.0.

The stock is believed to be native. Although North Fork Stillaguamish summer chinook are distinct from stocks examined in other Puget Sound systems, it is not known if this stock differs genetically from the Stillaguamish fall stock for which a baseline has not yet been established.

STOCK STATUS

Stock status is Depressed based upon chronically low escapement levels. The escapement estimates since 1985 are based upon counts of redds and considered to be consistent from year to year. A study to improve escapement estimates is currently underway. Escapement levels averaged 879 from 1985-1991. Together with the Stillaguamish fall chinook average of 145, average escapement is considerably below the combined summer/fall chinook escapement goal of 2,000 fish. The escapement goal has not been reached since 1976.

The Stillaguamish Tribe conducts a tagging and supplementation program for summer chinook. This program contributed to the increased escapements in 1991 and 1992.

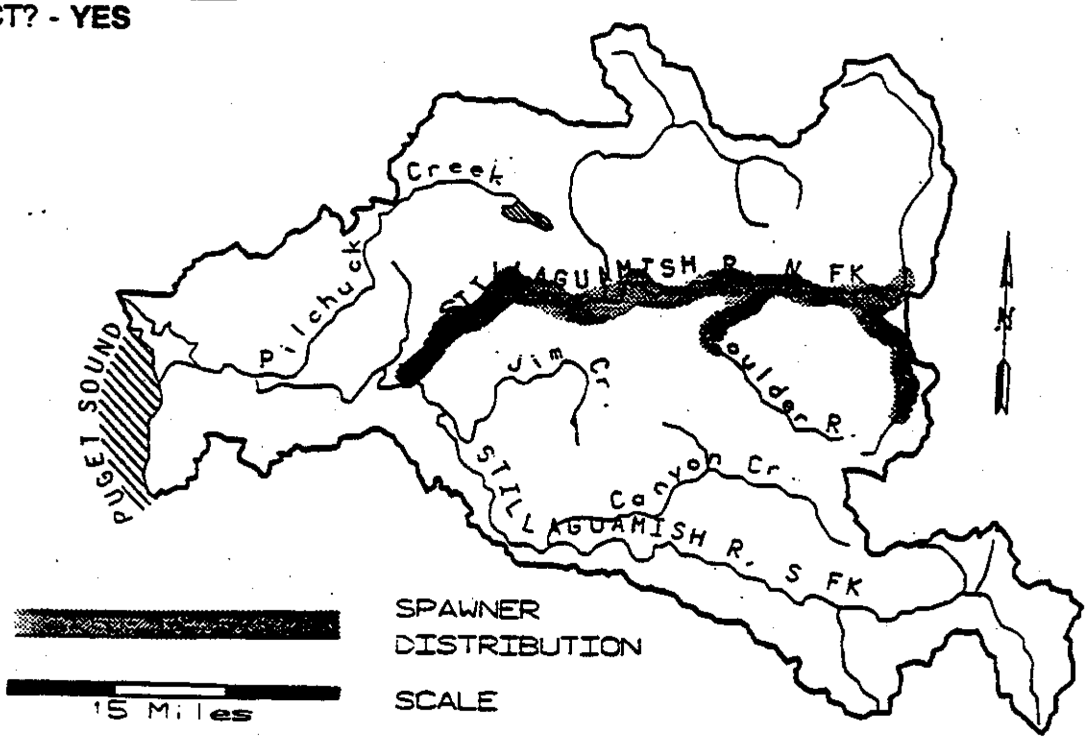
FACTORS AFFECTING PRODUCTION

Habitat - The stream gradient in areas of greatest spawning activity is moderate with alternating wide riffles and pools.

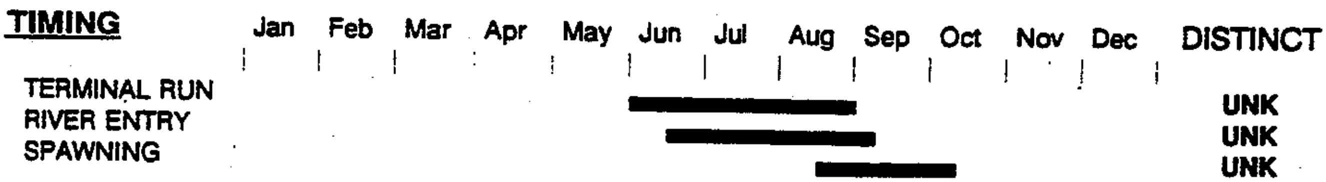
One important natural limiting factor affecting chinook egg survival in major spawning areas in the North Fork is sedimentation. A major clay-ridden landslide near Hazel, which occurred during the 1950s, affected mainstem spawning for several years (Williams, Laramie and Ames 1975). Considerable suspended and bedload sediment continues to be delivered to the mainstem from upstream sources within the North Fork. Other limiting habitat factors affecting summer chinook in the North Fork are loss of deep pools for adult holding, low summer flows and high water temperature.

STOCK DEFINITION PROFILE for Stillaguamish Summer Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

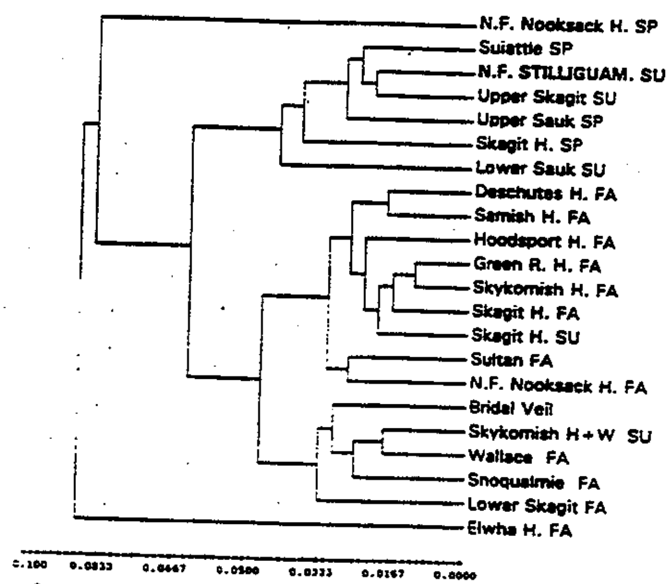


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Genetic data for NF Stillaguamish summer chinook sampled in 1987-88 show them to be significantly different ($p < 0.05$) from all other Puget Sound stocks examined. However, they do share some genetic similarities with a 1986 sample of Upper Skagit summer chinook.



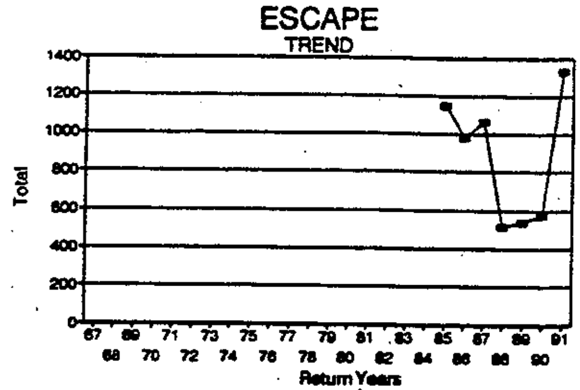
Genetic distance (modified Rogers distance (Wright, 1978); UPGMA)

STOCK STATUS PROFILE for Stillaguamish Summer Chinook

STOCK ASSESSMENT

DATA QUALITY-----> Very Good

Return Years	ESCAPE Total			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85	1148			
86	960			
87	1065			
88	516			
89	537			
90	575			
91	1331			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Composite

STOCK DISTINCTION
Distribution, Timing, Genetics

STOCK STATUS
Depressed

SCREENING CRITERIA
Chronically Low

Deer Creek, which enters the North Fork at RM 14.3 has also experienced catastrophic slides and sedimentation. A major slide near DeForest Creek, believed to be natural but arguably aggravated by extensive logging, has generated massive sediment loads into Deer Creek. Heavy logging has left the riparian areas along Deer Creek and its tributaries devoid of temperature-moderating shade and a source of large woody debris. In addition to this slide, numerous small slides continue to deliver sediment to the channel. Secondary habitat impacts include bank protection projects and gravel removal.

Upstream migration and adult holding habitat in the mainstem Stillaguamish are affected by summer low flows and high temperatures, especially in the lower river where sloughs have slow moving, exposed water. Agricultural and residential uses have contributed to the poor water quality on the lower river (Paulsen, Thornburgh and Rawson 1991). Approximately 90% of the lower estuary and associated wetlands have been extensively diked and converted to agricultural lands. This has resulted in an extensive loss of rearing area for juvenile salmonids.

Harvest Management

Preterminal Fisheries - Chinook from the Stillaguamish River are caught in fisheries in Alaska and Canada and in the following preterminal fisheries in U.S. waters: Strait of Juan de Fuca (Areas 4B, 5 and 6C) sport, net and troll fisheries; Fraser River sockeye/pink-directed net fisheries in the Strait of Juan de Fuca, the San Juan Islands (Area 7) and the Cherry Point-Boundary Bay area (Area 7A), and sport fisheries in the eastern Strait of Juan de Fuca (Area 6), Deception Pass/Saratoga Pass (Area 8) and Admiralty Inlet (Area 9). The Admiralty Inlet sport fishery is open year round except for autumn closures designed to protect weak coho stocks returning to spawn.

Terminal Fisheries - Stillaguamish chinook are managed for natural escapement and production in terminal and extreme terminal areas.

In addition to being caught in preterminal fisheries, Stillaguamish chinook are also caught in coho-directed net fisheries near Seattle (Area 10), Port Gardner/Port Susan (Area 8A) and the Tulalip Bay vicinity (Area 8D). There have been no chinook-directed net fisheries in the Stillaguamish River since 1983 or in Port Gardner/Port Susan since 1984.

The sport fishery in Port Susan is closed from mid-April through the end of August to protect Stillaguamish chinook. The Stillaguamish River is open for sport fishing for chum only from the beginning of November through the end of December. Chinook must be released.

The Puget Sound Salmon Stock Review Group (1992) examined catches of Stillaguamish summer/fall chinook (no distinction was made between summer and fall-run chinook). The report indicates that for the 1980-1986 broods, fisheries in Canada accounted for nearly 60% of the Stillaguamish summer/fall chinook fishing mortality. Alaska fisheries took about 5% of the Stillaguamish chinook catch. Puget Sound sport fisheries took approximately 24% of the total catch of Stillaguamish chinook; Puget Sound net fisheries accounted for a little more than 10% of the catch, and Puget Sound troll fisheries took about 2% of the total catch of Stillaguamish chinook. The Pacific Salmon Commission Joint Chinook Technical Committee's (1992) review of Stillaguamish chinook catch from 1984-1986 produced similar results. The Puget Sound Salmon Stock Review Group also pointed out that from 1980-1984 the adult equivalent exploitation rate on Stillaguamish chinook was approximately 65%, considerably higher than the maximum sustainable harvest level (MSH) of 50%, but has dropped to about 50% in recent years.

Hatchery - Hatchery operational impacts have not been determined. The Washington Department of Wildlife rears trout and steelhead on the North Fork. The Stillaguamish Tribe rears summer chinook, coho, chum and winter steelhead. Chinook brood stock is taken off the spawning grounds. Pairs of males and females are selected randomly. If proposed pairs would result in crosses between two hatchery-reared fish (recognizable by adipose fin clips), the random selection process is reiterated until the pairing is between a wild fish and a hatchery-reared fish or between two wild fish.

Last ten years salmon releases into the Stillaguamish basin.

Release Year	Summer Chinook	Chum	Coho	Pink
1982	100000	400000	0	105000
1983	33782	1159855	0	0
1984	95982	95000	0	737000
1985	0	3549000	0	0
1986	0	2001100	15000	633500
1987	49900	438300	138750	0
1988	149741	57600	0	0
1989	41123	971044	0	0
1990	46837	99832	39020	0
1991	69100	366798	5156	0
MEAN	73308	913853	49482	491833

STILLAGUAMISH -- STILLAGUAMISH FALL CHINOOK

STOCK DEFINITION AND ORIGIN

This stock has been classified as separate from the Stillaguamish summer stock due to a distinct spawn-timing difference and a less distinct difference in geographical spawning distribution. Stillaguamish fall chinook spawn in October with the peak of spawning typically in the first week of October. Spawning occurs throughout the mainstem and the South Fork Stillaguamish River.

The origin of this stock is unknown. Releases of non-native fall chinook have occurred in the Stillaguamish system. The peak spawn timing of the Stillaguamish fall chinook stock is similar to other Puget Sound fall chinook stocks (such as Green River and Samish). Until a genetic analysis is completed, it is unclear whether this stock is truly distinct from other Puget Sound fall chinook stocks.

STOCK STATUS

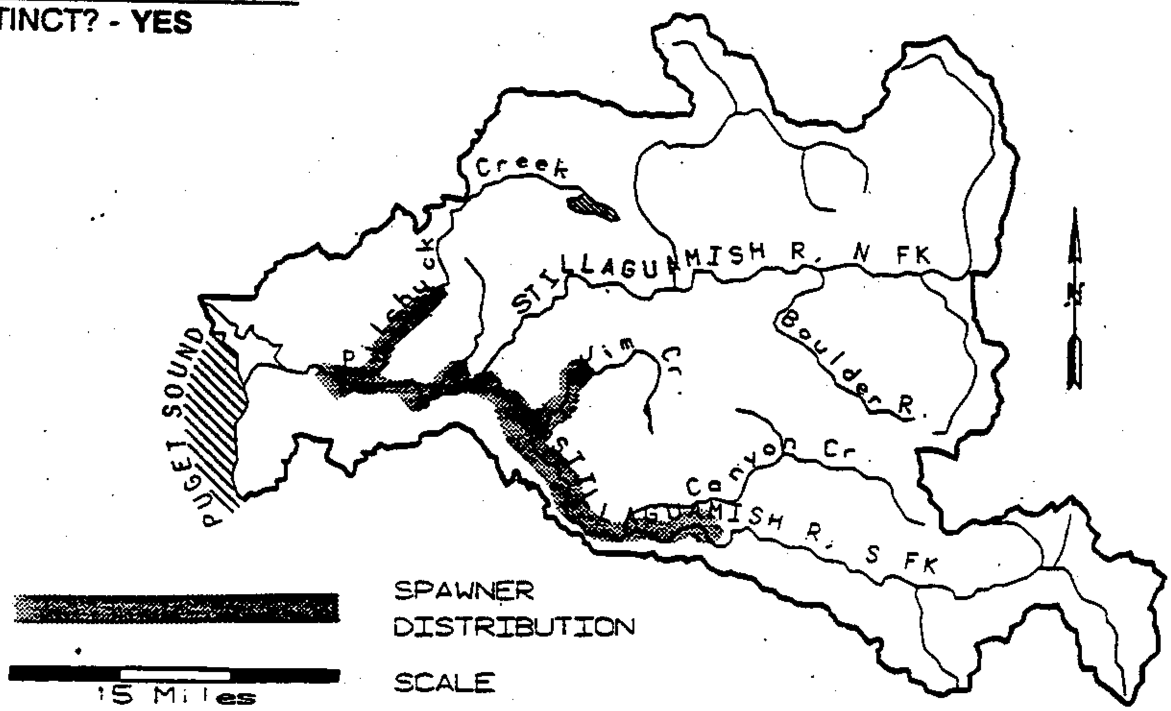
Stock status is Depressed due to chronically low escapement estimates. Escapement estimates are based on redd counts and are comparable from year to year beginning in 1985. The average escapement from 1985-1991 is 145. Coupled with the average escapement of Stillaguamish summer chinook of 879, the average escapement is under the goal of 2,000 summer/fall chinook. This escapement goal has not been reached since 1976.

FACTORS AFFECTING PRODUCTION

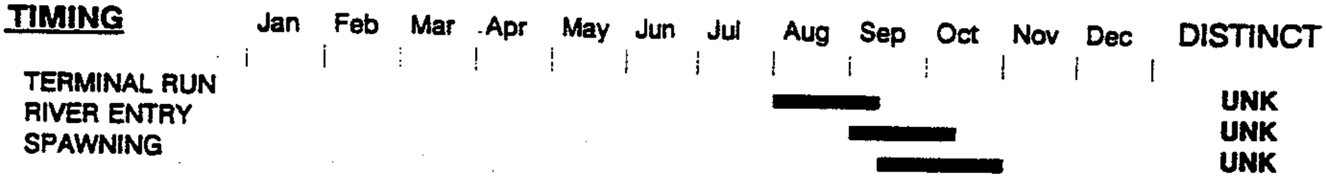
Habitat - Access to the South Fork Stillaguamish above Granite Falls is limited by attraction, sedimentation and flow problems, poor entrance conditions at the Granite Falls fishway and by a rock fall in Robe Canyon which may be a migration barrier. There is a coho trapping and hauling operation which transports small numbers of Stillaguamish fall chinook around Granite Falls and Robe Canyon. The fishway should be upgraded in the next three years. A passage improvement project in Robe Canyon is scheduled for 1994. Adult migration and adult holding habitat in the mainstem Stillaguamish are affected by summer low flows and high temperatures, especially in the lower river where sloughs have slow moving, exposed water. Agricultural and residential uses have contributed to the poor water quality on the lower river (Paulsen, Thornburgh and Rawson 1991). Approximately 90% of the lower estuary and associated wetlands have been extensively diked and converted to agricultural lands. This has resulted in an extensive loss of rearing area for juvenile salmonids. One major South Fork natural limiting factor is sedimentation from a major slide in the Gold Basin area. Heavy logging has added to the sedimentation problem, as well as contributing to the loss of large woody debris recruitment to the channel and possibly to elevated water temperature. Similar natural and human-

STOCK DEFINITION PROFILE for Stillaguamish Fall Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

GENETICS - No data available.

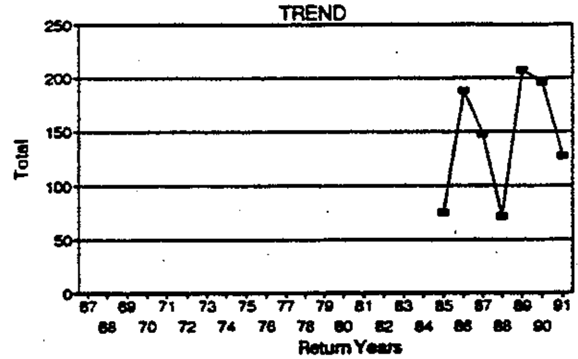
STOCK STATUS PROFILE for Stillaguamish Fall Chinook

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85	75			
86	188			
87	148			
88	72			
89	207			
90	196			
91	128			

ESCAPE
TREND



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Unknown

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Depressed

SCREENING CRITERIA
Chronically Low

caused impacts have occurred in Jim Creek and Canyon Creek. Bank protection projects constructed to protect homes near the mainstem and larger tributaries have removed or damaged riparian vegetation and caused flow constrictions and loss of pool habitat.

Harvest Management

Preterminal Fisheries - Chinook from the Stillaguamish River are caught in fisheries in Alaska and Canada and in the following preterminal fisheries in U.S. waters: Strait of Juan de Fuca (Areas 4B, 5 and 6C) sport, net and troll fisheries; Fraser River sockeye/pink-directed net fisheries in the Strait of Juan de Fuca, the San Juan Islands (Area 7) and the Cherry Point-Boundary Bay area (Area 7A), and sport fisheries in the eastern Strait of Juan de Fuca (Area 6), Deception Pass/Saratoga Pass (Area 8) and Admiralty Inlet (Area 9). The Admiralty Inlet sport fishery is open normally year-round except for autumn closures designed to protect weak coho stocks returning to spawn.

Terminal Fisheries - Stillaguamish chinook are managed for natural escapement and production in terminal and extreme terminal areas.

In addition to being caught in preterminal fisheries, Stillaguamish chinook are also caught in coho-directed net fisheries near Seattle (Area 10), Port Gardner/Port Susan (Area 8A) and the Tulalip Bay vicinity (Area 8D). There have been no chinook-directed net fisheries in the Stillaguamish River since 1983 or in Port Gardner/Port Susan since 1984.

The sport fishery in Port Susan is closed from mid-April through the end of August to protect Stillaguamish chinook. The Stillaguamish River is usually open for sport fishing for chum only from the beginning of November through the end of December. Chinook must be released.

The Puget Sound Salmon Stock Review Group (1992) examined catches of Stillaguamish summer/fall chinook (no distinction was made between summer and fall run chinook) and found for that the 1980-1986 broods, fisheries in Canada accounted for nearly 60% of the Stillaguamish summer/fall chinook fishing mortality. Alaska fisheries took about 5% of the Stillaguamish chinook catch. Puget Sound sport fisheries took approximately 24% of the total catch of Stillaguamish chinook; Puget Sound net fisheries accounted for a little more than 10% of the catch, and Puget Sound troll fisheries took about 2% of the total catch of Stillaguamish chinook. The Pacific Salmon Commission Joint Chinook Technical Committee's (1992 review of Stillaguamish chinook catch from 1984-1986 produced similar results. The Puget Sound Salmon Stock Review Group also pointed out that from 1980-1984 the adult equivalent exploitation rate on Stillaguamish chinook was approximately 65%, considerably higher than the maximum sustainable harvest level (MSH) of 50%, but has dropped to about 50% in recent years.

Hatchery - Hatchery operational impacts have not been determined. The Washington Department of Wildlife rears trout and steelhead on the North Fork, and the Stillaguamish Indian Tribe rears summer chinook, coho and chum.

Last ten years salmon releases into the Stillaguamish basin.

Release Year	Summer Chinook	Chum	Coho	Pink
1982	100000	400000	0	105000
1983	33782	1159855	0	0
1984	95982	95000	0	737000
1985	0	3549000	0	0
1986	0	2001100	15000	633500
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1988	149741	57600	0	0
1989	41123	971044	0	0
1990	46837	99832	39020	0
1991	69100	366798	5156	0
MEAN	73308	913853	49482	491833

OVERVIEW -- STILLAGUAMISH FALL CHUM STOCKS

NORTH FORK STILLAGUAMISH
SOUTH FORK STILLAGUAMISH

STOCK DEFINITION AND ORIGIN

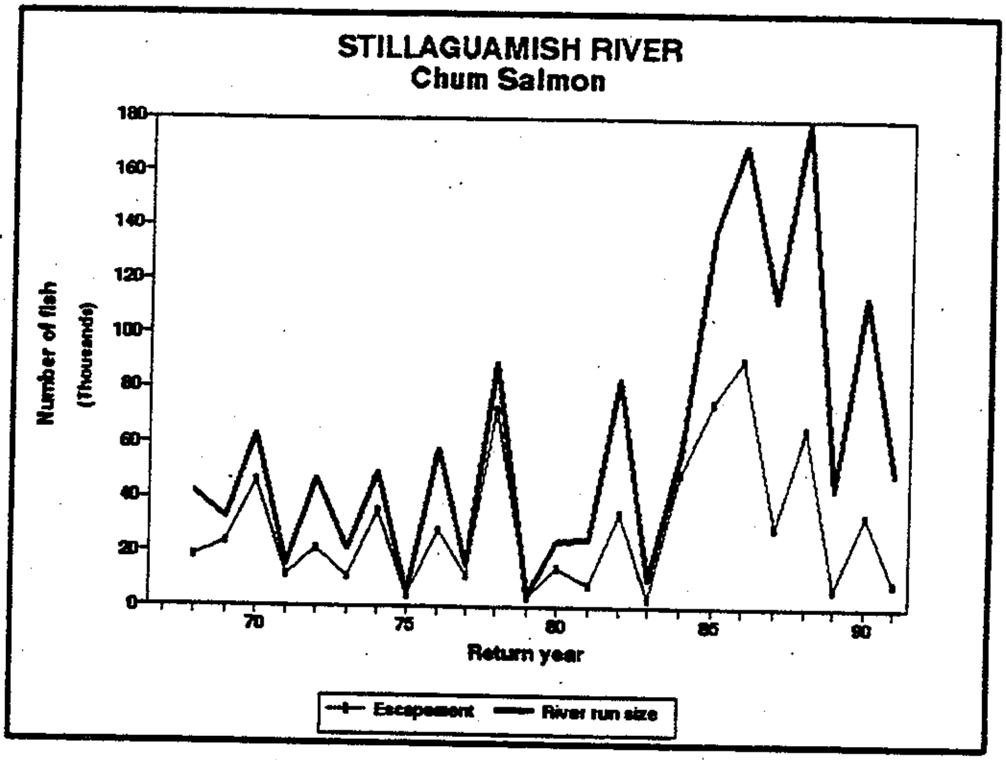
Chum salmon in the Stillaguamish are separated from other chum stocks geographically. Within the system, chum are tentatively divided into two stocks, North Fork and South Fork, because of geographical separation and timing differences. Chum introduced into the mainstem tributaries are derived for the most part from North Fork and should be included with that group pending further investigation.

Chum salmon begin entering the Stillaguamish in September and continue to enter through December with the peak entry from early to mid-November. Spawning occurs from mid-October through December.

Stillaguamish chum are thought to be native. There have been no recent introductions of non-native chum into the system, although Grays Harbor chum were introduced in 1916. Genetic analysis has shown that Stillaguamish chum are distinct from other Puget Sound stocks although Stillaguamish chum are related to Skagit and Snohomish chum. Stock separations within the Stillaguamish system are unclear. Further investigation is needed.

STOCK STATUS

The estimated annual number of adults returning to the Stillaguamish River to spawn over the last ten years has ranged from 57,000 to 180,000 for even-numbered years and from 10,000 to 140,000 for odd-numbered years. Escapement estimates have ranged from 34,000 to 92,000 for even years and from 3,300 to 76,000 for odd years. Current escapement goals are 33,100 for even years and 13,100 for odd years (see figure). The difference in the ranges between even and odd years may be due to competition with pink salmon which are present in odd-year broods only. Stillaguamish chum are taken in mixed-stock net fisheries in the Strait of Juan de Fuca (Areas 4b, 5 and 6C), the San Juan Islands (Areas 6, 7 and 7A) and Admiralty Inlet (Area 9) and are targeted in commercial fisheries in Area 8A and the Stillaguamish River. Chum are also taken in freshwater and saltwater sport fisheries.



Total returns are calculated from escapement estimates and harvest data and do not include Canadian interceptions. Escapement estimates are based on a comparison of spawning ground counts in designated index areas with counts for the same areas made during years when escapements were estimated by tagging studies, The accuracy of the these figures is unknown, but they are valuable for showing trends because of the consistency in survey methods and personnel.

More information on each stock is presented in separate Stock Reports.

STILLAGUAMISH -- NORTH FORK STILLAGUAMISH FALL CHUM

STOCK DEFINITION AND ORIGIN

North Fork Stillaguamish chum are separated from all other Puget Sound chum stocks geographically and genetic differences. There are also some timing differences. Spawning in the North Fork and its tributaries occurs during November and December with the peak coming in late November or early December. Spawning is known to occur in the mainstem from Grant Creek (RM 9.0) upstream at least as far as Squire Creek (RM 31.0). The Squire Creek drainage is heavily used for chum spawning. Other tributaries, including Grant, Boulder and Fortson creeks, are also used for spawning.

North Fork Stillaguamish chum are thought to be native.

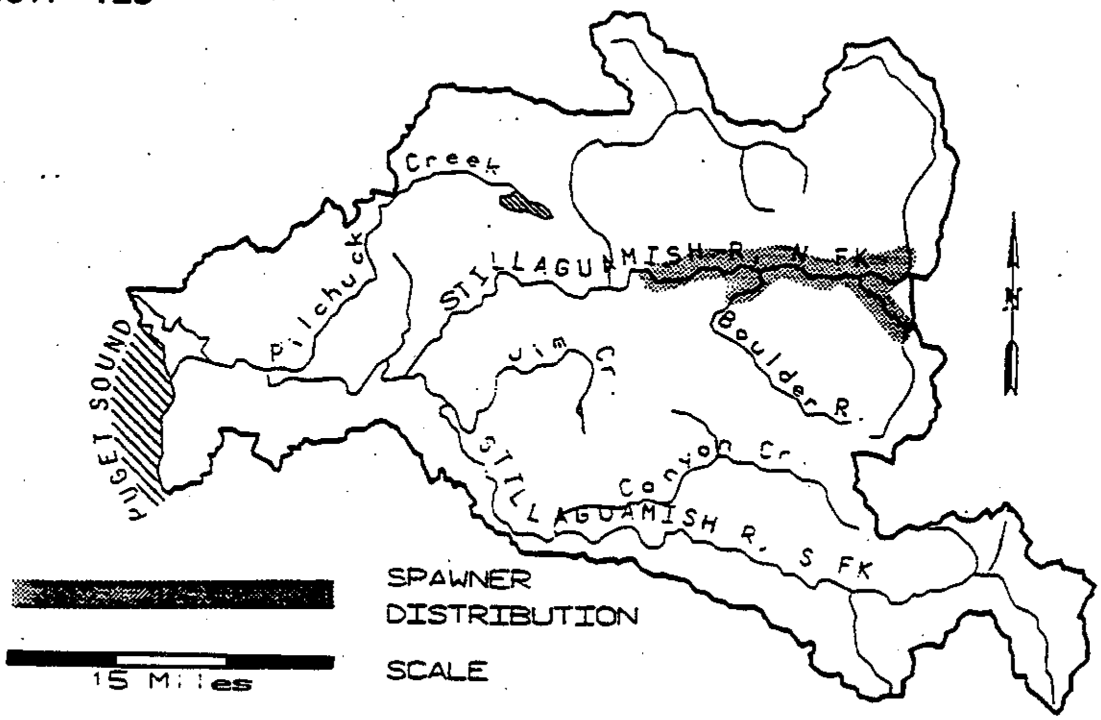
STOCK STATUS

The status of the stock is Healthy.

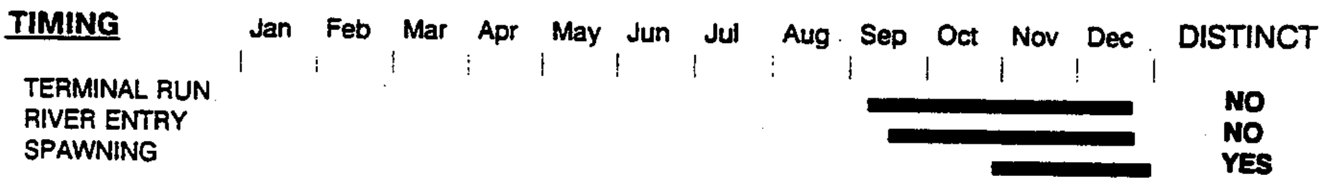
Total escapement estimates are not generated for the various components of the Stillaguamish chum run. Spawning ground index counts can be used to illustrate trends in abundance within single components of the run. These counts are reliable for the specific areas surveyed but do no reflect localized changes in abundance outside the areas that are regularly surveyed. Index areas include Squire Creek and its tributaries, Furland, Ashton and Browns creeks; Grant Creek; Fortson Creek and the mainstem North Fork from Hazel (RM 22.0) to Whitehorse (RM 30.0).

STOCK DEFINITION PROFILE for North Fork Stillaguamish Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

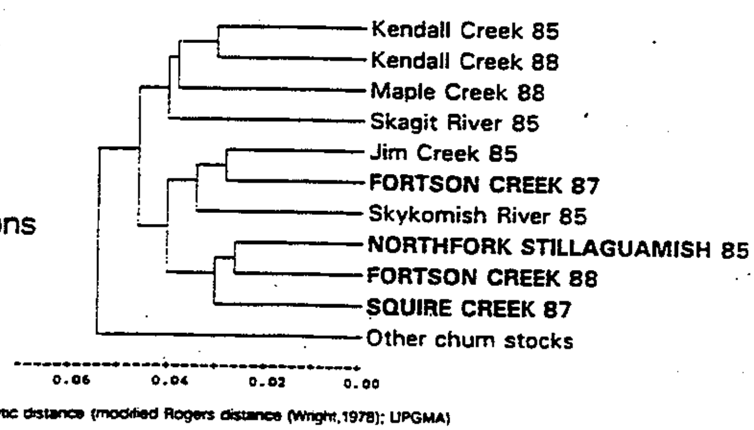


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Locations in the North Fork Stilliguamish River were sampled for genetic analysis four times from 1985-1988, (N=380). Sampling is continuing. Data analysis shows considerable genetic heterogeneity within the Stillaguamish basin. However, the four North Fork collections are significantly distinct (21-locus G-tests: $p<0.05$) from all other Washington and Canadian GSI collections from outside the Stillaguamish basin.

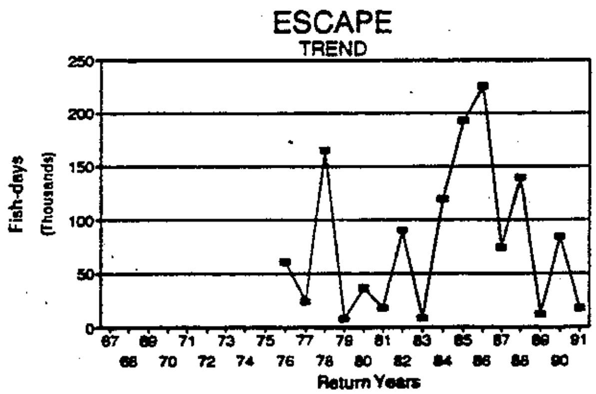


STOCK STATUS PROFILE for North Fork Stillaguamish Fall Chum

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Fish-days			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76	60793			
77	23958			
78	165506			
79	8003			
80	36486			
81	18136			
82	90242			
83	8736			
84	119470			
85	192572			
86	225209			
87	74232			
88	139902			
89	11804			
90	84773			
91	17749			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Genetics

STOCK STATUS
Healthy

SCREENING CRITERIA

STILLAGUAMISH -- SOUTH FORK STILLAGUAMISH FALL CHUM

STOCK DEFINITION AND ORIGIN

South Fork Stillaguamish chum are separated from all other chum stocks geographically. There are also some timing differences. Spawning in the South Fork and its tributaries may begin in mid- to late October and continue through November and December with the peak apparently coming in mid- to late November. However, chronically poor stream visibility makes it difficult to characterize spawning timing in the South Fork drainage. Complete data are available only for Jim Creek and only for years when visibility was good.

Chum are known to spawn in the South Fork from the confluence to Granite Falls (RM 34.0). Jim Creek is heavily used for spawning, and chum may enter other tributaries as well.

South Fork chum are thought to be of native origin because there is no record of any introduction of non-native fish.

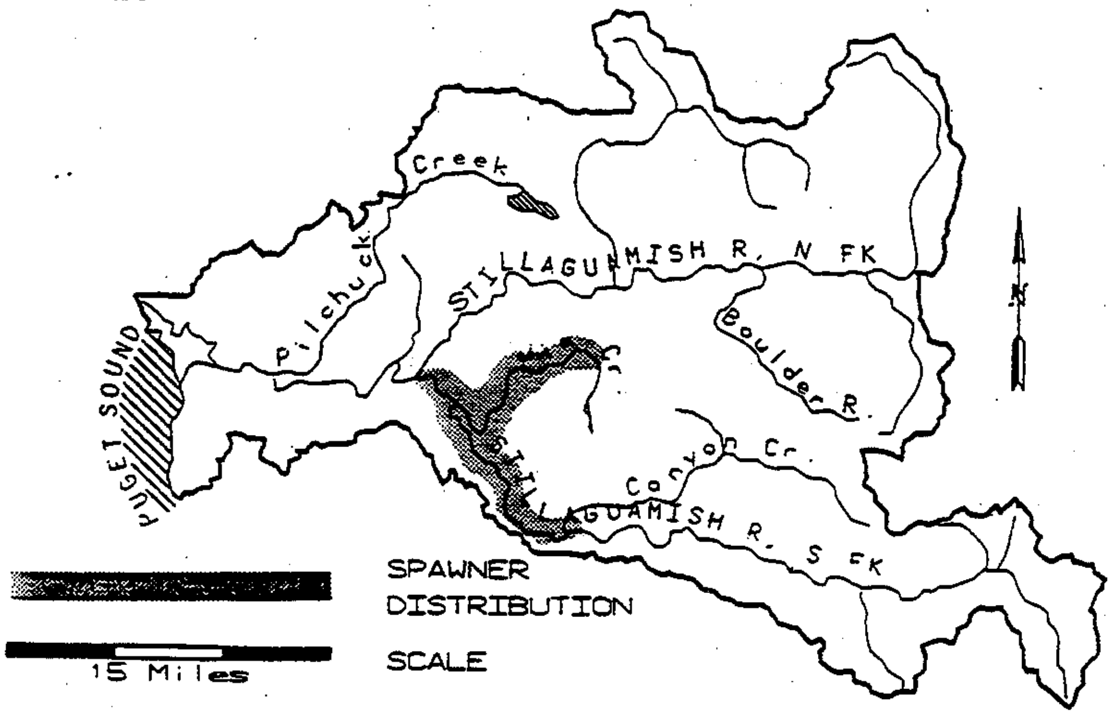
STOCK STATUS

The status of the stock is Healthy.

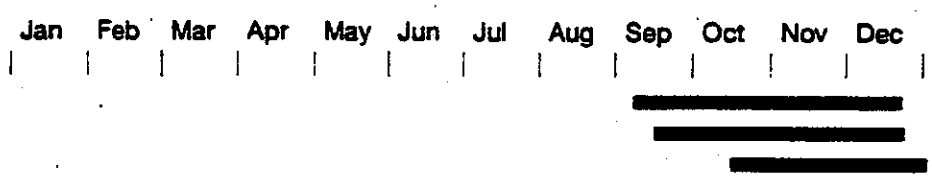
Total escapement estimates are not generated for the various components of the Stillaguamish chum run. Spawning ground index counts can be used to illustrate trends in abundance within single components of the run. These counts are reliable for the specific areas surveyed but do no reflect localized changes in abundance outside of the areas that are regularly surveyed. Jim Creek and its tributary Siberia Creek are the only index areas in the South Fork drainage. Coverage of Jim Creek is often incomplete because of poor visibility.

STOCK DEFINITION PROFILE for South Fork Stillaguamish Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



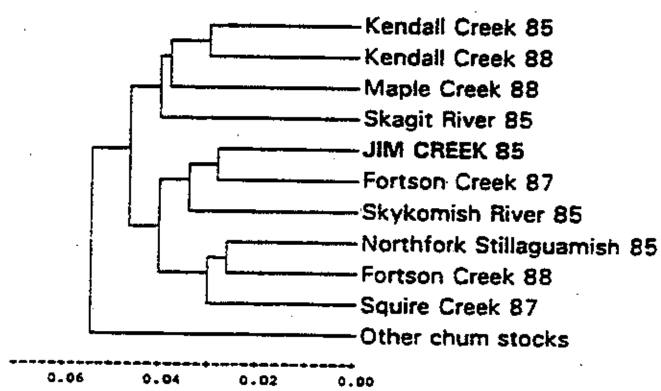
TIMING



TIMING	DISTINCT
TERMINAL RUN	**NO**
RIVER ENTRY	**NO**
SPAWNING	**YES**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Fish from Jim Creek in the South Fork Stilliguamish River were sampled for genetic analysis in 1985 (N=100). Analysis of these data indicates significant genetic heterogeneity within the Stillaguamish basin. This collection is significantly distinct (21-locus G-tests: $p<0.05$) from all other Washington and Canadian GSI collections from outside the Stillaguamish basin.



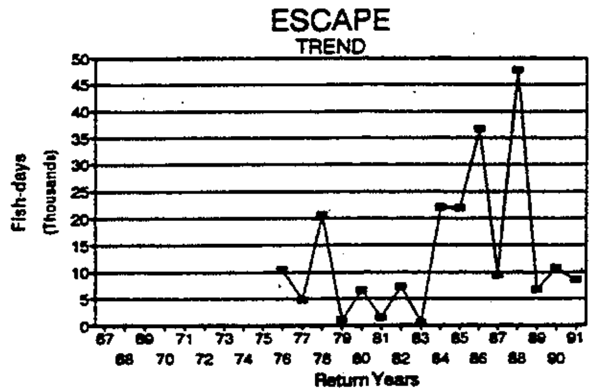
Genetic distance (modified Rogers distance (Wright, 1978); UPGMA)

STOCK STATUS PROFILE for South Fork Stillaguamish Fall Chum

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Fish-days			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76	10523			
77	4754			
78	20784			
79	890			
80	6662			
81	1510			
82	7250			
83	518			
84	22021			
85	21975			
86	36707			
87	9491			
88	47757			
89	6767			
90	10763			
91	8539			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Genetics

STOCK STATUS
Healthy

SCREENING CRITERIA

OVERVIEW -- STILLAGUAMISH COHO STOCKS

STILLAGUAMISH
DEER CREEK

STOCK DEFINITION AND ORIGIN

Coho salmon utilize almost all of the accessible tributaries draining into this river system. Coho returning to these tributaries typically enter freshwater in September and October and spawn from mid-November through January, with some variation among streams and among years within streams.

There were substantial releases of hatchery-origin coho fingerlings/fry and yearlings in this system from the early 1950s to 1981. As a result, the Stillaguamish coho stock may be considered a mixture of native and non-native fish, although the contribution of these hatchery fish to naturally spawning coho stock in this system is unknown. There are no significant timing differences or other unique characteristics among other Stillaguamish coho, so they have been classified as a single stock. Currently the Stillaguamish Tribe conducts a coho brood stock program using fish derived from naturally spawning parents and hatchery-spawned parents.

Limited data indicate that a stock of coho returns to the Deer Creek drainage in August and early September, significantly earlier than other coho in the Stillaguamish system. There have been no releases of hatchery-origin fish into Deer Creek. Consequently Deer Creek coho are considered to be native and distinct from other Stillaguamish coho.

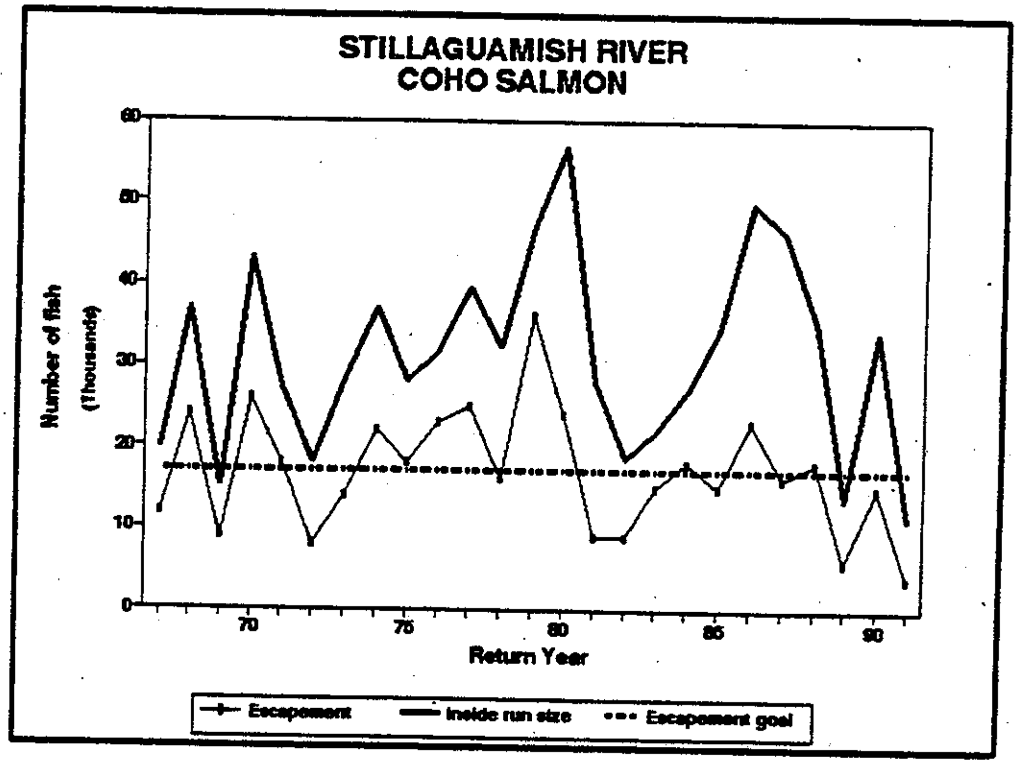
STOCK STATUS

Stillaguamish basin coho are harvested primarily in Canadian troll, net and sport fisheries and in Washington troll, net and sport fisheries. There are also river fisheries on this stock.

The escapement goal for naturally spawning fish is 17,000. The run reconstruction database shows escapement and run-size estimates (escapements plus Puget Sound net catches), from 1965 to the present, fluctuating over a broad range with escapements meeting the goal in 12 of those 27 years. Stillaguamish stock performance evaluation is based on a stock assessment database dating back to 1977 with broader coverage beginning in 1984 and on the run reconstruction data. Both of these sources indicate a relatively stable performance over the long term. However, the 1989 and 1991 production levels are the lowest recorded, indicating a short-term severe decline and cause for concern. There are insufficient stock assessment data available for the Deer Creek stock to make any statements regarding its status, so it has been classified as Unknown.

The figure below, which illustrates natural coho production trends in this basin is derived from the run reconstruction database. The current escapement goal is plotted for all years on this graph although this goal was not adopted for harvest management purposes until 1978.

More information on each stock is presented in separate Stock Reports.



STILLAGUAMISH -- STILLAGUAMISH COHO

STOCK DEFINITION AND ORIGIN

This stock does not exhibit any unique spawning or run timing (spawning from November to mid-January, occasionally into February) or any documented distinct biological characteristics. It is believed that there is limited straying into this system from surrounding drainages, so this stock has been defined by its distinct spawning distribution. There are currently no data available to confirm multiple distinct stocks within this drainage under the three criteria listed above.

There were off-station releases into this system of hatchery-origin coho yearlings from the early 1950s to 1981. Skagit and Skykomish stocks were predominant (each stock was released for eight years) with significant Samish introductions (five years) and lesser use of Green River and Issaquah stocks (two years each). Fingerlings and/or fry were also released off-station during this time period, using the same stocks as for yearling releases. Skagit stock was used in 14 different years, while the other four stocks were used for four to six years each. It is assumed that some of these hatchery fish survived and spawned, so this stock has been classified as a mixture of native and introduced non-native fish.

STOCK STATUS

The status of the stock is Depressed.

This stock's performance has been relatively stationary over the entire database, with the exceptions of the 1989 and 1991 returns. The estimated escapements and run sizes for these two years are the lowest recorded and indicate a short-term severe decline.

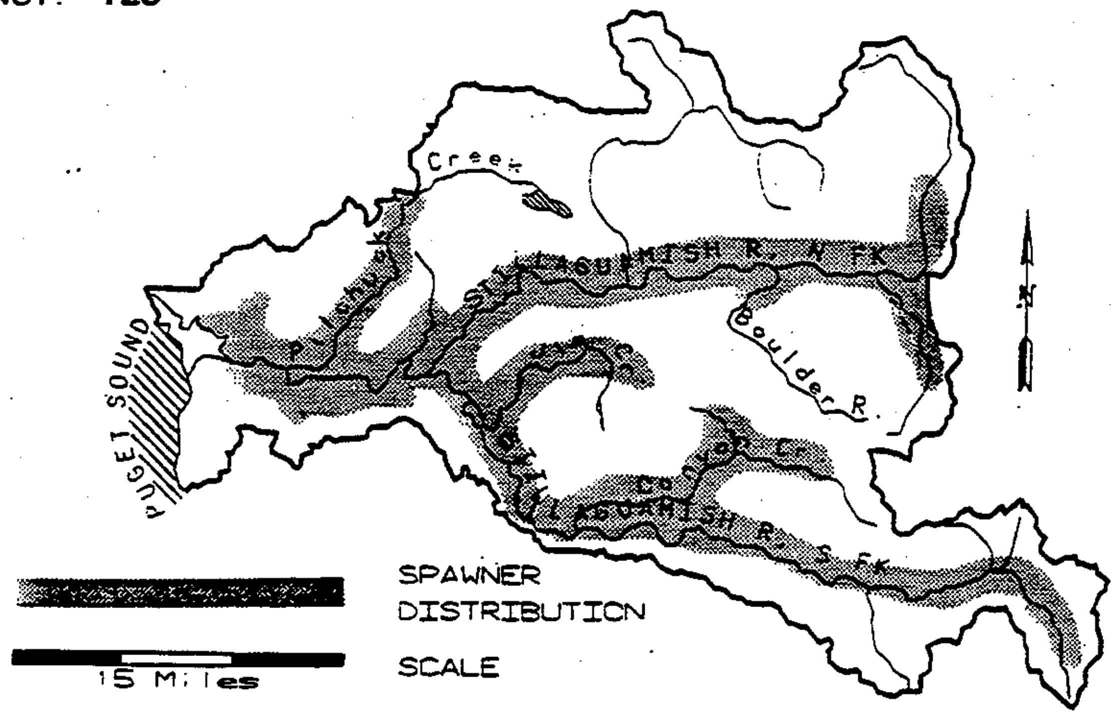
Spawning escapement estimates for this stock are based on routine surveys of seven geographically well-distributed index areas which are compared with counts for the same index areas made in 1977 when escapements were determined using tagging studies. In 1984 the indices were expanded, so there is a broader base of data from that point on. Run reconstruction data best reflect this stock's production trend.

FACTORS AFFECTING PRODUCTION

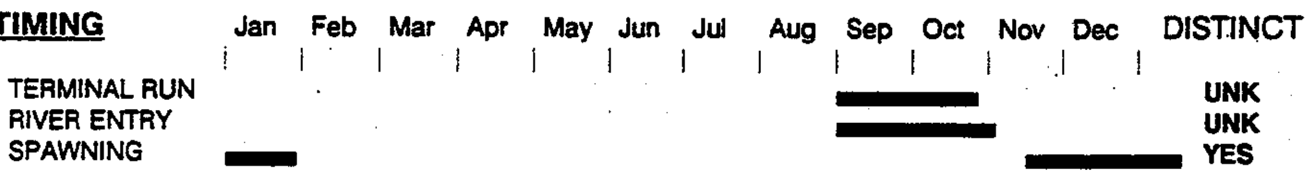
Habitat - Migration and rearing habitats in the mainstem Stillaguamish are affected by summer low flows and high temperatures in the lower river where sloughs have slow moving, exposed water. Agricultural and residential uses have contributed to the poor water quality on the lower river (Paulsen, Thornburgh and Rawson 1991). Approximately 90% of the lower estuary and associated wetlands have been extensively diked and converted to agricultural lands. This has resulted in an extensive loss of rearing area for juvenile salmonids.

STOCK DEFINITION PROFILE for Stillaguamish Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING



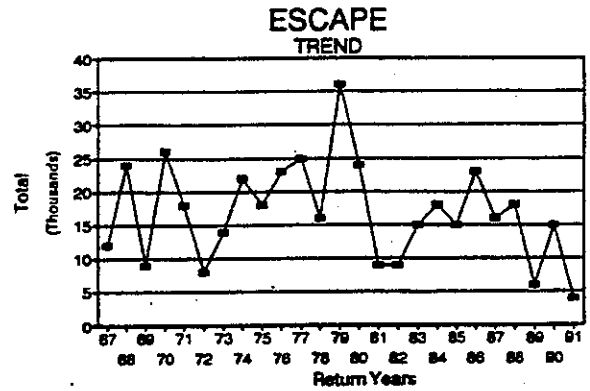
BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

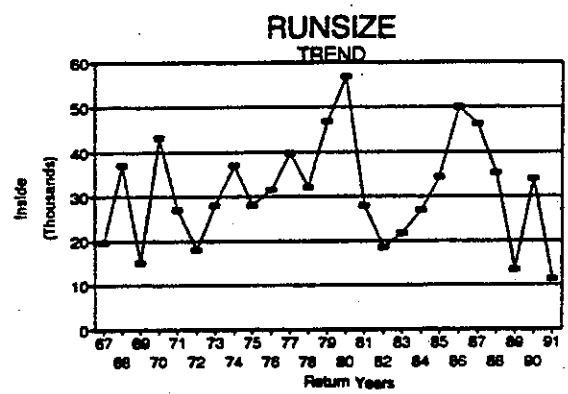
STOCK STATUS PROFILE for Stillaguamish Coho

STOCK ASSESSMENT

DATA QUALITY-----> Good

Return Years	ESCAPE Total	RUNSIZE Inside		
67	12000	19700		
68	24000	37000		
69	9000	15100		
70	26000	43300		
71	18000	27200		
72	8000	18000		
73	14000	28100		
74	22000	37000		
75	18000	28000		
76	23000	31600		
77	25000	39600		
78	16000	32100		
79	36000	46900		
80	24000	56700		
81	9000	27900		
82	9000	18600		
83	15000	21800		
84	18000	26900		
85	15000	34400		
86	23000	49900		
87	16000	46300		
88	18000	35400		
89	6000	13500		
90	15000	34100		
91	4000	11300		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Mixed

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Depressed

SCREENING CRITERIA
Short Term Severe Decline

Access to the South Fork Stillaguamish above Granite Falls is limited by attraction, sedimentation and flow problems and poor entrance conditions at the fish ladder at the falls and by a rock fall in Robe Canyon which may be a migration barrier. Currently there is a trapping and hauling operation which transports coho around Granite Falls. The fish ladder should be upgraded in the next three years.

Production in tributary streams is limited naturally by summer low flows. Human impacts include sedimentation and diminished pool habitat from logging road construction and timber harvest. Water pollution from agricultural chemicals and manure is common and severe in some cases.

Harvest Management - Stillaguamish coho are harvested primarily in Canadian troll, net and sport fisheries and Washington net and sport fisheries. In the 1987-1989 time period, 55% of the harvest occurred in Canadian fisheries and 45% in Washington fisheries. In the preterminal areas, harvest rates on Stillaguamish River coho are generally determined by the needs of other Puget Sound natural coho stocks or by other species. In the terminal fishery in Port Gardner, Port Susan and Saratoga Pass (Area 8A), the harvest rate is set to meet the escapement needs for the natural stocks of both the Stillaguamish and Snohomish drainages. The terminal area fishery in the Stillaguamish River is managed for the appropriate harvest rate on Stillaguamish natural coho.

The average annual exploitation rate on Stillaguamish River coho in the 1987-1989 period was approximately 87% (landed catch only). Marine survival rates have not been measured for this stock, but it seems likely that this harvest rate is above optimum for this stock.

Hatchery - Hatchery operational impacts have not been determined. The Washington Department of Fish and Wildlife rears trout and steelhead in a rearing and release pond on the North Fork, and the Stillaguamish Tribe rears summer chinook, coho and chum.

Last ten years salmon releases into the Stillaguamish basin.

Release Year	Summer Chinook	Chum	Coho	Pink
1982	100000	400000	0	105000
1983	33782	1159855	0	0
1984	95982	95000	0	737000
1985	0	3549000	0	0
1986	0	2001100	15000	633500
1987	49900	438300	138750	0
1988	149741	57600	0	0
1989	41123	971044	0	0
1990	46837	99832	39020	0
1991	69100	366798	5156	0
MEAN	73308	913853	49482	491833

STILLAGUAMISH -- DEER CREEK COHO

STOCK DEFINITION AND ORIGIN

We have very little data for this stock. Limited Washington Department of Wildlife surveys in the early 1950s indicated a run of coho returning to this stream in August and early September. Spawn timing is unknown. This stock was defined by its unique early run timing, as it did not, to our knowledge, exhibit any other unique biological characteristics. This stock may have had a limited geographic distribution as well, but that cannot be confirmed at this time.

There have been no known introductions of non-native coho into this system except for one release of 200,000 Skykomish yearlings near the mouth of Deer Creek in 1980. The stock is considered to be native.

STOCK STATUS

The status of this stock is Unknown.

Attempts to survey spawning grounds in the Deer Creek system have been largely unsuccessful due to poor visibility and lack of access. The only stock assessment information available for Deer Creek and its tributaries (Rick, Little Deer and DeForest creeks) is very limited juvenile sampling performed between 1981 and 1991. Those data indicate that there is very little coho utilization of this habitat at this time. Unless the majority of this stock's juveniles rear in the mainstem or in other tributary drainages, it appears that this stock may be extremely depressed or nonexistent.

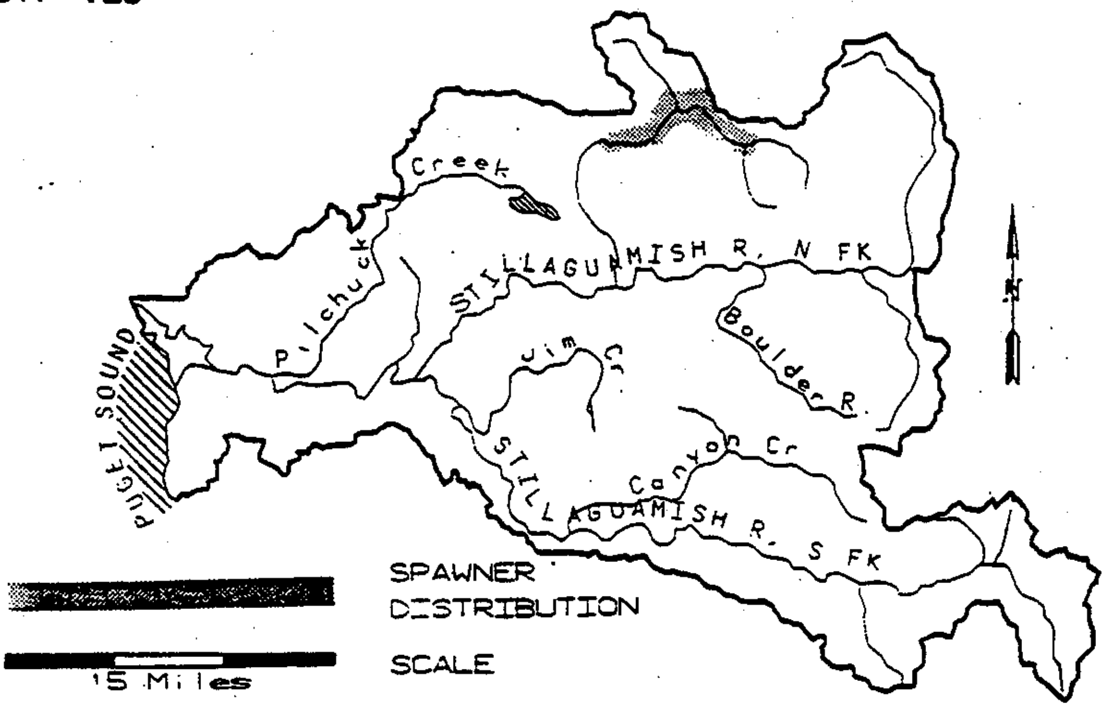
FACTORS AFFECTING PRODUCTION

Habitat - Deer Creek has experienced catastrophic land slides and sedimentation. A major landslide near DeForest Creek, believed to be natural but arguably aggravated by extensive logging, has generated massive loads of sediment in Deer Creek. In addition to this slide, numerous smaller slides continue to deliver sediment to the channel. Heavy logging has left the riparian areas along Deer Creek and its tributaries devoid of temperature-moderating shade and a source of large woody debris. Secondary habitat impacts include bank protection and gravel removal. This habitat degradation is especially damaging to coho which must rear through the summer and following winter prior to outmigration. The excessive bedload in the mainstem Deer Creek has resulted in long reaches where the deepest part of the stream is isolated from what remains of shade-producing riparian vegetation. As a result, summer water temperatures are very high. Stranding is common as summer flows go subsurface for long distances. Winter refuge cover is lacking in the mainstem due to a lack of large woody debris.

Harvest Management - Harvest impacts on this stock are unknown.

STOCK DEFINITION PROFILE for Deer Creek Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY								▬					**YES**
SPAWNING													**UNK**

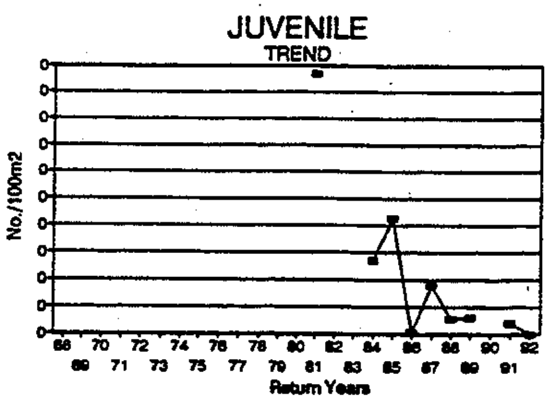
BIOLOGICAL CHARACTERISTICS
DISTINCT? - **NO**

STOCK STATUS PROFILE for Deer Cr Coho

STOCK ASSESSMENT

DATA QUALITY-----> Poor

Return Years	JUVENILE No./100m2			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81	0.2			
82				
83				
84	0.1			
85	0.1			
86	0.0			
87	0.0			
88	0.0			
89	0.0			
90				
91	0.0			
92	0.0			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution, Timing

STOCK STATUS

Unknown

SCREENING CRITERIA

Hatchery - Hatchery operational impacts have not been determined. The Washington Department of Fish and Wildlife rears trout and steelhead in a rearing and release pond on the North Fork, and the Stillaguamish Tribe rears summer chinook, coho and chum.

Last ten years salmon releases into the Stillaguamish basin.

Release Year	Summer Chinook	Chum	Coho	Pink
1982	100000	400000	0	105000
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1986	0	2001100	15000	633500
1987	49900	438300	138750	0
1988	149741	57600	0	0
1989	41123	971044	0	0
1990	46837	99832	39020	0
1991	69100	366798	5156	0
MEAN	73308	913853	49482	491833

OVERVIEW -- STILLAGUAMISH PINK STOCKS

NORTH FORK STILLAGUAMISH
SOUTH FORK STILLAGUAMISH

STOCK DEFINITION AND ORIGIN

Stillaguamish pink salmon are separated from other pink salmon stocks geographically. The division of Stillaguamish pinks into two stocks (North Fork and South Fork) is based on geographical separation and on differences in entry timing and spawn timing. The degree of genetic isolation is not known. The two river forks differ in geomorphology and temperature and may favor different physical characteristics in fish populations, particularly those involving spawning and larval development. However, it is also possible that mixing stocks may occur, especially during drought years such as 1979 and 1987 when access into the upper North Fork was difficult.

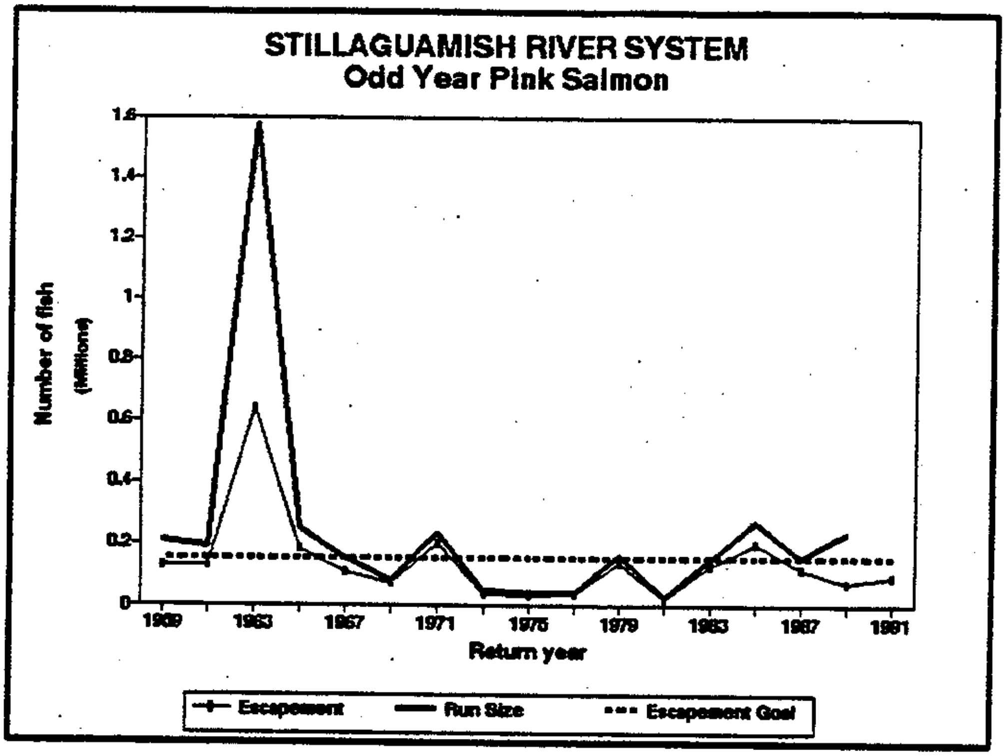
Pink salmon enter the Stillaguamish from early August to early October. Spawning begins in early September and continues through October. Stillaguamish pinks spawn in odd-numbered years only, although pinks are occasionally reported during even-numbered years. Spawning may take place along the entire accessible length of the North Fork and to Granite Falls on the South Fork as well as in the mainstem.

Stillaguamish pinks are assumed to be of native origin with no known hatchery influence. The only known introductions of pinks were from an even-year stock, the last of which took place about 40 years ago.

STOCK STATUS

Estimates of the total number of adult pink salmon (both stocks combined) returning to the Stillaguamish during odd-numbered years have ranged from 48,000 to 361,000 over the last ten cycles. Numbers of spawners in the system are estimated to range from 18,000 to 200,000 over the last ten cycles. The present escapement goal is 155,000 (see figure). Estimated total returns are calculated from escapement estimates and harvest data and include Canadian interceptions. Stillaguamish pink salmon are taken in mixed stock net fisheries and are targeted by tribal and commercial fisheries in Port Gardner/Port Susan (Area 8A). They are also taken in tribal freshwater net fisheries in the Stillaguamish River and in saltwater and freshwater sport fisheries. Differences between the North Fork and South Fork stocks in contributions to fisheries are unknown.

Escapement estimates are based on a comparison of spawning ground counts in designated index areas with counts in the same index areas made during 1959, 1961, 1963 and 1987 when escapements were determined by tagging studies. The 1987 study has improved the recent estimates since there have been changes in habitat



and spawner distribution since the earlier studies. Separation of the escapement estimates into North Fork and South Fork components is more subjective. It is based on the expansion of the spawning ground index counts.

Escapements fluctuate greatly from year to year with no apparent trend. This may be because pinks in the Stillaguamish are especially vulnerable to environmental conditions, primarily drought and flooding, which occur sporadically.

More information on each stock is presented in separate Stock Reports.

STILLAGUAMISH -- NORTH FORK STILLAGUAMISH PINK

STOCK DEFINITION AND ORIGIN

North Fork Stillaguamish pink salmon are separated from other stocks geographically. They spawn in the mainstem North Fork of the Stillaguamish and its larger tributaries (Squire and Boulder creeks). If sufficient flows exist, they may enter other tributaries including Grant, French, Segelsen and Brown's creeks. This stock spawns in odd-numbered years only, although pinks are occasionally reported during even-numbered years. Spawning may take place along the entire accessible length of the North Fork with the heaviest spawning activity between RM 27.0 and RM 34.0. Boulder and especially Squire creeks generally have heavy spawning although access may be limited by low flows. Spawning in the North Fork begins in early September and continues through October, usually peaking in late September. Spawning generally begins earliest near the headwaters and progresses downstream with time.

Stillaguamish pinks are assumed to be of native origin with no known hatchery influence.

STOCK STATUS

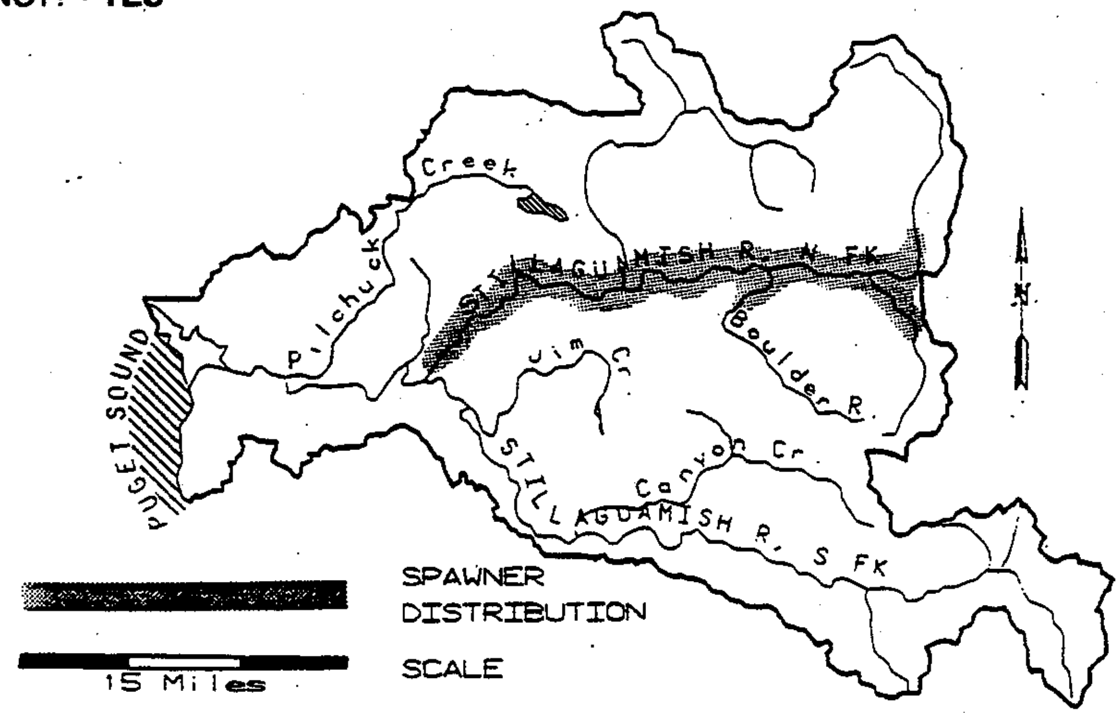
The status of the stock is Healthy based on trends in spawning escapement.

Escapement estimates are generated for the system as a whole. These estimates can be separated into North Fork and South Fork components by expanding spawning ground index counts. However, this is not an accurate procedure. Estimated escapement to the North Fork has ranged from 7,700 to 147,000 since 1975.

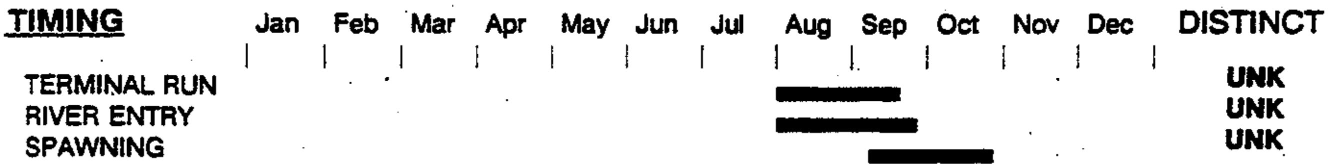
STOCK DEFINITION PROFILE for North Fork Stillaguamish Pink

SPAWNER DISTRIBUTION

DISTINCT? - **YES**



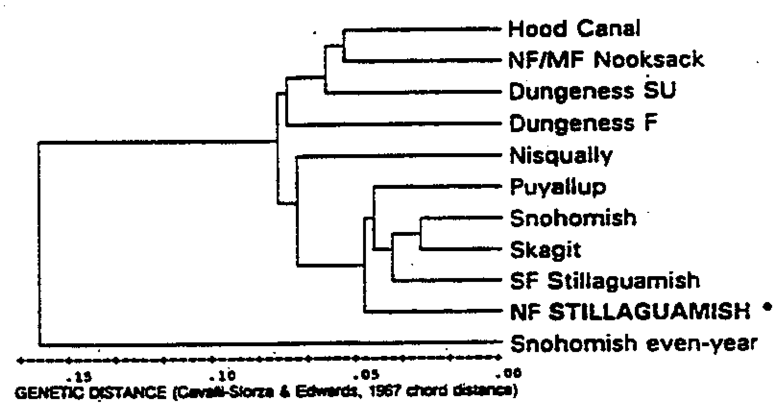
TIMING



BIOLOGICAL CHARACTERISTICS

DISTINCT? - **YES**

GENETICS - The stock in the North Fork is significantly different from that in the South Fork [one collection from Squire Creek (N=100); 28-locus G-test vs. South Fork Stillaguamish: $p<0.05$].



STOCK STATUS PROFILE for North Fork Stillaguamish Pink

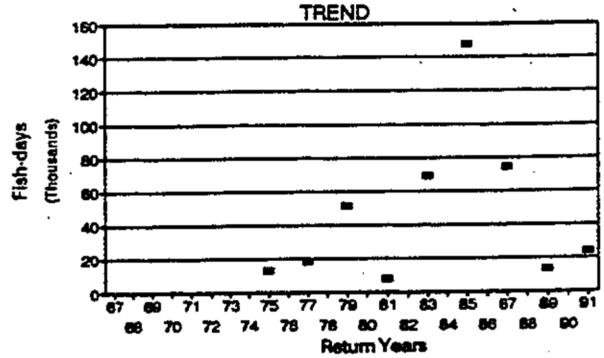
STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Fish-days			
67				
68				
69				
70				
71				
72				
73				
74				
75	13044			
76				
77	18503			
78				
79	51280			
80				
81	7754			
82				
83	69292			
84				
85	147459			
86				
87	74339			
88				
89	13423			
90				
91	23783			

Odd-year returns only.

ESCAPE



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution, Genetics

STOCK STATUS

Healthy

SCREENING CRITERIA

STILLAGUAMISH -- SOUTH FORK STILLAGUAMISH PINK

STOCK DEFINITION AND ORIGIN

South Fork Stillaguamish pink salmon are separated from other pink salmon stocks geographically. There are also differences in river entry and spawn timing. Mainstem and Pilchuck Creek Pinks are included with this stock because of similarities in timing.

Pink salmon may enter the Stillaguamish from early August to early October with those bound for the South Fork entering in late August and peaking in mid-September. Spawning in the South Fork and Jim Creek begins in late September and continues through October with a peak in mid-October. Pilchuck Creek pinks have similar timing, although low flows may delay entry.

South Fork Stillaguamish River pink salmon spawn in the mainstem South Fork below Granite Falls and its larger tributaries, especially Jim Creek. Spawners also enter Canyon Creek and, if flows are adequate, may enter other tributaries including Jordan Creek. Mainstem spawning occurs from the mouth of Canyon Creek (RM 34.0) downstream past the mouth of the North Fork as far as Sylvana (RM 6.0) (For river mileage the South Fork is considered a continuation of the mainstem Stillaguamish.) The greatest concentration of spawners occurs in Jim and Pilchuck creeks and the mainstem South Fork (RM 19.0 to RM 30.0). This stock spawns only in odd-numbered years.

Stillaguamish pinks are assumed to be of native origin with no known hatchery influence.

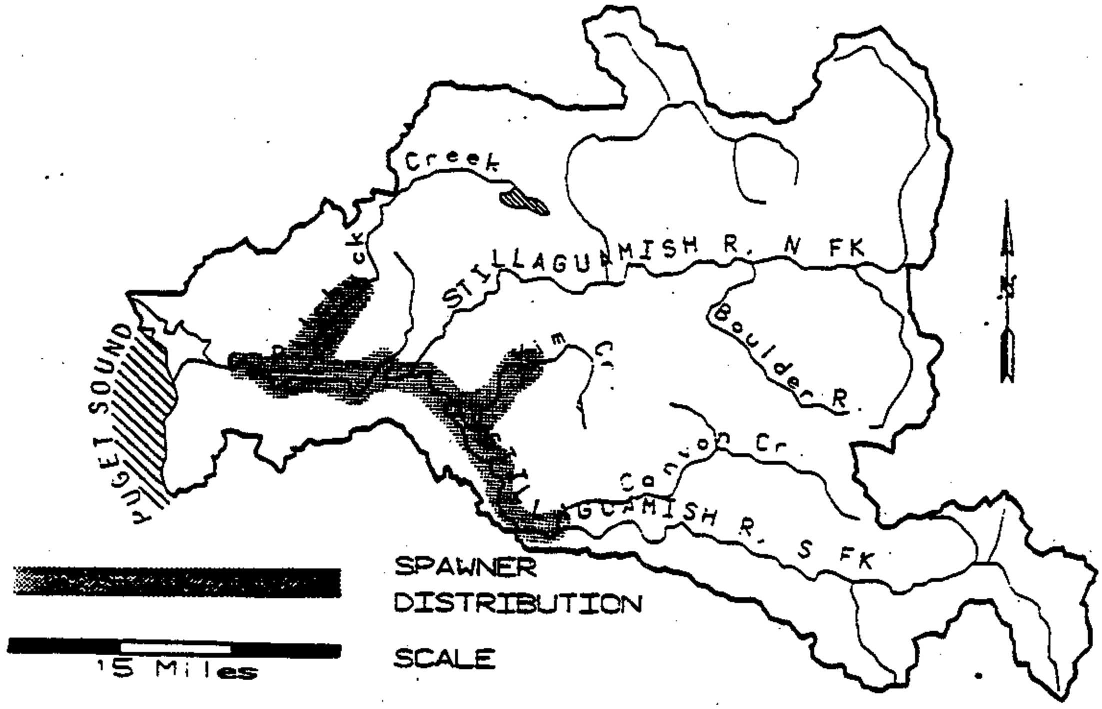
STOCK STATUS

The status of the stock is Healthy based on trends in spawning escapement.

Escapement estimates are generated for the system as a whole. These estimates can be separated into North Fork and South Fork components by expanding spawning ground index counts. However, this method is very subjective. Estimated escapements to the South Fork and Pilchuck Creek have ranged from 10,000 to 74,000 since 1975.

STOCK DEFINITION PROFILE for South Fork Stillaguamish Pink

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

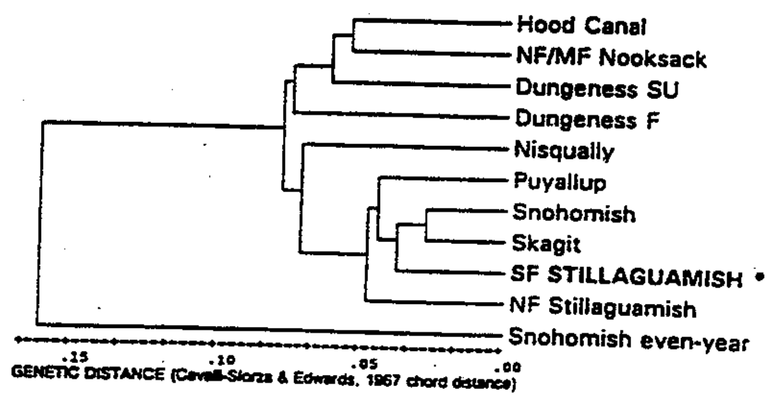


TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN								▬	▬				**NO**
RIVER ENTRY								▬	▬				**YES**
SPAWNING									▬	▬			**YES**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Population in the South Fork is significantly different from that in the North Fork [collections from mainstem and Pilchuck Creek (N=185); 28-locus G-test vs. NF Stillaguamish: $p<0.05$].



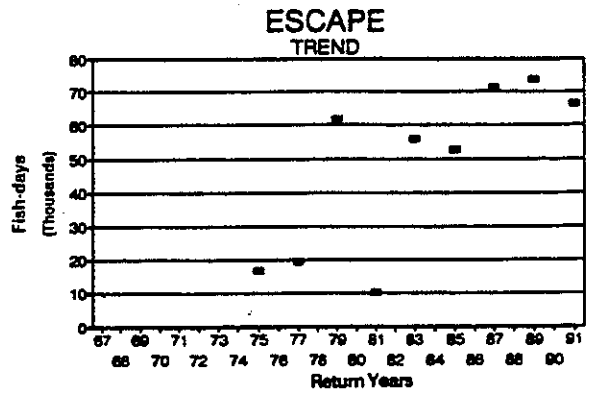
STOCK STATUS PROFILE for South Fork Stillaguamish Pink

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Fish-days			
67				
68				
69				
70				
71				
72				
73				
74				
75	16956			
76				
77	19497			
78				
79	61720			
80				
81	10246			
82				
83	55708			
84				
85	52541			
86				
87	71361			
88				
89	73577			
90				
91	66217			

Odd-year returns only.



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Genetics

STOCK STATUS
Healthy

SCREENING CRITERIA

OVERVIEW -- STILLAGUAMISH SUMMER AND WINTER STEELHEAD STOCKS

SUMMER:
DEER CREEK
SOUTH FORK STILLAGUAMISH
CANYON CREEK

WINTER:
STILLAGUAMISH

STOCK DEFINITION AND ORIGIN

In the Stillaguamish River system, three summer steelhead stocks and one winter steelhead stock have been identified: wild summer steelhead in Deer Creek, South Fork Stillaguamish, and Canyon Creek and wild winter steelhead in the Stillaguamish River. Wild winter steelhead in the Stillaguamish River and summer steelhead in Deer Creek are native. The South Fork Stillaguamish River summer stock originated from non-native fish, and the Canyon Creek summer stock is a mixture of native and non-native stocks.

The stocks are treated separately due to the geographical isolation of the spawning populations. There may be more or fewer stocks identified once comprehensive genetic information is available.

Run-timing of the summer steelhead stocks (May through October) is distinct from run-timing of the winter steelhead stock (November through April) in the Stillaguamish River system.

The native summer stocks developed in areas isolated from the native winter stocks. In the Stillaguamish River system this occurs upstream of falls that were probable migration barriers except during the low flows of summer and fall. Since only a few miles of stream were used, the summer steelhead population in Canyon Creek was small. The Deer Creek stock could have numbered from 1,000 to 2,000 adults historically.

While about 100,000 to 130,000 hatchery winter steelhead smolts are planted in the Stillaguamish River system annually, there is little contribution to the wild stock from hatchery fish spawning in the wild. The returning hatchery adults support tribal and sport fisheries with a high exploitation rate. Given the difference in spawn-timing between the hatchery fish (January and February) and the wild fish (mid-February through June), the potential for interbreeding is limited.

About 80,000 hatchery summer steelhead smolts are stocked in the Stillaguamish River system annually. The potential for interbreeding between the more numerous hatchery fish and the wild fish certainly exists in the South Fork Stillaguamish and Canyon Creek, but the contribution to the wild stock by hatchery fish spawning in the wild is unknown. No hatchery summer steelhead have been found in Deer Creek during sampling of adult steelhead. Management strategies are presently being reviewed to reduce potential interbreeding.

STOCK STATUS

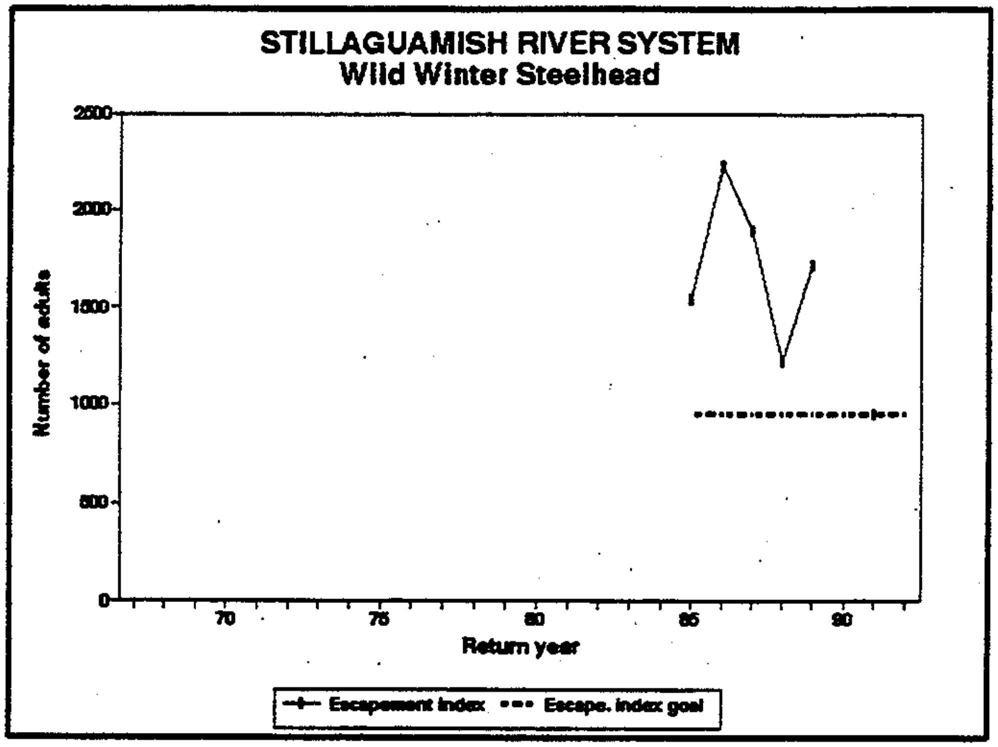
Wild winter steelhead spawner escapement has been measured in the North Fork Stillaguamish River as an index for the Stillaguamish River system since the 1984-85 season. An escapement goal for the index of 950 winter steelhead was set in 1984-85 and escapement in the index has ranged from 950 to 2,226 fish, exceeding the goal in all years measured (see figure and table).

The wild winter steelhead run in the Stillaguamish River system is fished upon by the Stillaguamish Tribe in the lower mainstem Stillaguamish and by the Tulalip Tribes in nearby marine waters (Area 8A). Sport anglers fish in the mainstem Stillaguamish, North Fork and South Fork Stillaguamish, and small tributaries (Pilchuck Creek and Canyon Creek). The targeted tribal fishery occurs primarily during December and January and is concentrated on the hatchery component of the winter run. The sport fishery occurs from November through March on the mainstem, through February on the South Fork and tributaries, and year around with wild steelhead release regulations from March 1 through November 30 on the North Fork.

Wild summer steelhead spawning escapement is not monitored and escapement goals have not been identified. However, juvenile densities have been measured in index areas in Deer Creek since 1984. There are no tribal fisheries that target Stillaguamish River system summer steelhead, but they may be caught incidentally in other tribal salmon and steelhead fisheries. These stocks have been managed with regulations to protect the wild stocks from sport harvest since 1984 on the North Fork and since 1986 on the mainstem Stillaguamish, but some hook-and-release mortality may occur. Deer Creek has been closed since the late 1930s. Because of the small population sizes and limited habitats used, the wild summer steelhead stock will always be fragile.

Wild steelhead release regulations have been in effect in all marine areas since 1993.

More information on each stock is presented in separate Stock Reports.



Stillaguamish River system wild winter steelhead sport harvest, tribal harvest, and spawner escapement (in index area) from 1984-85 through 1991-92.

Return year	Sport harvest	Tribal harvest[a]	Spawner escapement
1984-85			1,542
1985-86			2,226
1986-87	565		1,892
1987-88	640		1,222
1988-89	432		1,716
1989-90	250		
1990-91	194		950
1991-92			
Mean sport harvest and escapement (in index area) 1984-85 to 1990-91.			
	416		1,591

[a] Hatchery/wild composition of tribal harvest is not available.

STILLAGUAMISH -- DEER CREEK SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in Deer Creek are a distinct stock based on the geographical isolation of the spawning population. This is the only steelhead stock (summer or winter) that uses the upper Deer Creek basin and the only native summer steelhead of the North Fork Stillaguamish. This is a race of small-sized steelhead with mid-summer to early fall run timing. Ninety-five percent of the run are three years old (having spent two years in freshwater then one plus year in saltwater) and 24 to 25 inches in length, and the remainder are four years old (having spent three years in freshwater and one plus year in saltwater) or repeat spawners.

Run-timing is generally from July through mid-October and spawn-timing is generally from early to mid-April through May for wild summer steelhead in this stock.

STOCK STATUS

The status of the wild summer steelhead stock is Critical. The stock is exhibiting a long-term negative trend in juvenile densities.

Juvenile densities have been measured in index areas since 1984. Since 95% of the population spawns at age 3, juvenile densities for different broodyears provide a measure of the population trends. In the last nine years, the population has been declining at a rate of about 30 to 50 percent per generation. For the broodyear starting in 1984, juvenile densities decreased from 0.111 fry per square meter (fry/m^2) in 1984 to 0.073 fry/m^2 in 1987 to 0.059 fry/m^2 in 1990. Similarly, for the broodyear starting in 1985, juvenile densities decreased from 0.606 fry/m^2 in 1985 to 0.150 fry/m^2 in 1988 to 0.047 fry/m^2 in 1991. For the broodyear starting in 1986, juvenile densities decreased from 0.165 fry/m^2 in 1986 to 0.102 fry/m^2 in 1989 to 0.071 fry/m^2 in 1992.

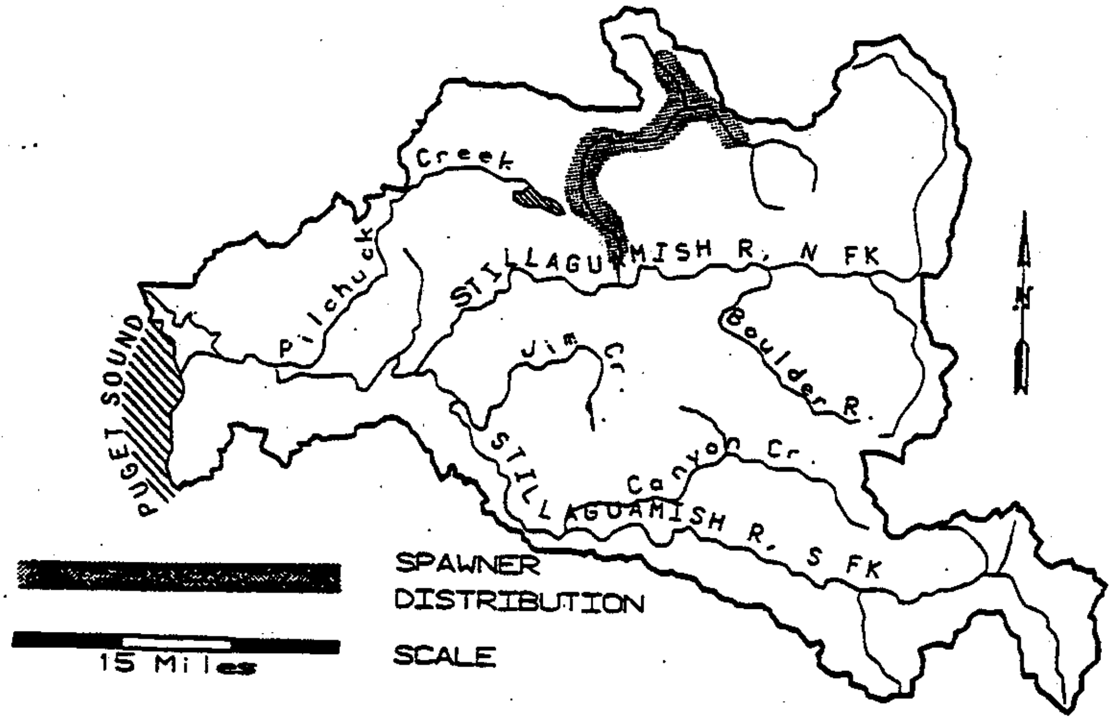
In addition, the run probably numbered from 1,000 to 2,000 adults per year historically. This estimate of historical population size is based on anecdotal reports. These are consistent with the number of steelhead the habitat theoretically could support, as well as with levels that would support the long-term harvest reported prior to 1960. The population is probably now at only about five to ten percent of historical levels.

FACTORS AFFECTING PRODUCTION

Habitat -- By far the largest limiting factor is the degraded habitat found in the Deer Creek Basin. The population is declining and is limited by habitat degradation (excessive bedload and elevated stream temperatures) caused by land management practices and naturally unstable soils and slopes. Excessive timber harvest has

STOCK DEFINITION PROFILE for Deer Cr Summer Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													NO
SPAWNING													NO

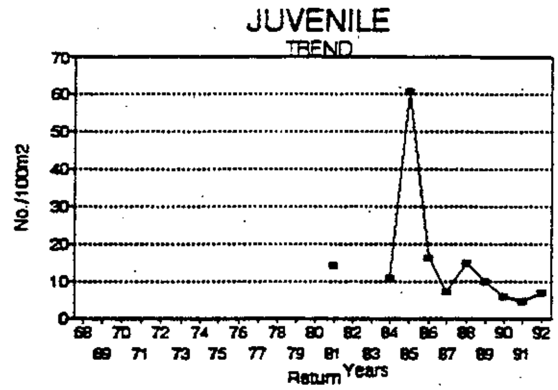
BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Deer Cr Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY——> Good

Return Years	JUVENILE No./100m2			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81	14.4			
82				
83				
84	11.1			
85	60.6			
86	16.5			
87	7.3			
88	15.0			
89	10.2			
90	5.9			
91	4.7			
92	7.1			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Critical

SCREENING CRITERIA
Long Term Negative Trend

resulted in extreme bedload movement (as much as 2,000,000 yards of material per year). This has resulted in unstable and compacted spawning areas, filling of the pool habitat and elevated stream temperatures. Summer stream temperatures may reach into the middle 70 degrees F.

Harvest Management -- There is no directed fishery on this stock. Incidental net harvest of this stock could occur during fisheries directed at salmon stocks in the Stillaguamish River and nearby marine waters from June through September. Deer Creek is closed to recreational fishing. Prior to 1986, sport fishery regulations allowed harvest of wild summer steelhead in other areas of the Stillaguamish River system and harvest of Deer Creek summer steelhead could have occurred. Beginning in 1992, all wild summer steelhead stocks in the system have been managed with wild steelhead release regulations to protect wild stocks from sport harvest, but some hook-and-release mortality may occur. Illegal harvest through poaching in the North Fork Stillaguamish and Deer Creek continues to be a concern.

Hatchery -- Sampling of adult steelhead within Deer Creek has found no hatchery steelhead. Hatchery summer steelhead have not been stocked in Deer Creek.

STILLAGUAMISH -- SOUTH FORK STILLAGUAMISH SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in the South Fork Stillaguamish River upstream of Granite Falls are a distinct stock based on the geographical isolation of the spawning population. Stock origin is non-native as it originated from hatchery steelhead fry and smolts introduced into the upper watershed after the construction of the fish ladder at Granite Falls in the mid-1950s. This stock is different from the winter steelhead in the area based on a summer run timing and an earlier spawning time.

Run-timing is generally from early May through October and spawn-timing is generally from mid-January to mid-April for wild summer steelhead in this stock.

STOCK STATUS

The status of this stock is Unknown.

This stock is probably increasing in abundance. With continuing wild steelhead release regulations protecting wild summer steelhead from sport harvest, this increase is expected to continue.

FACTORS AFFECTING PRODUCTION

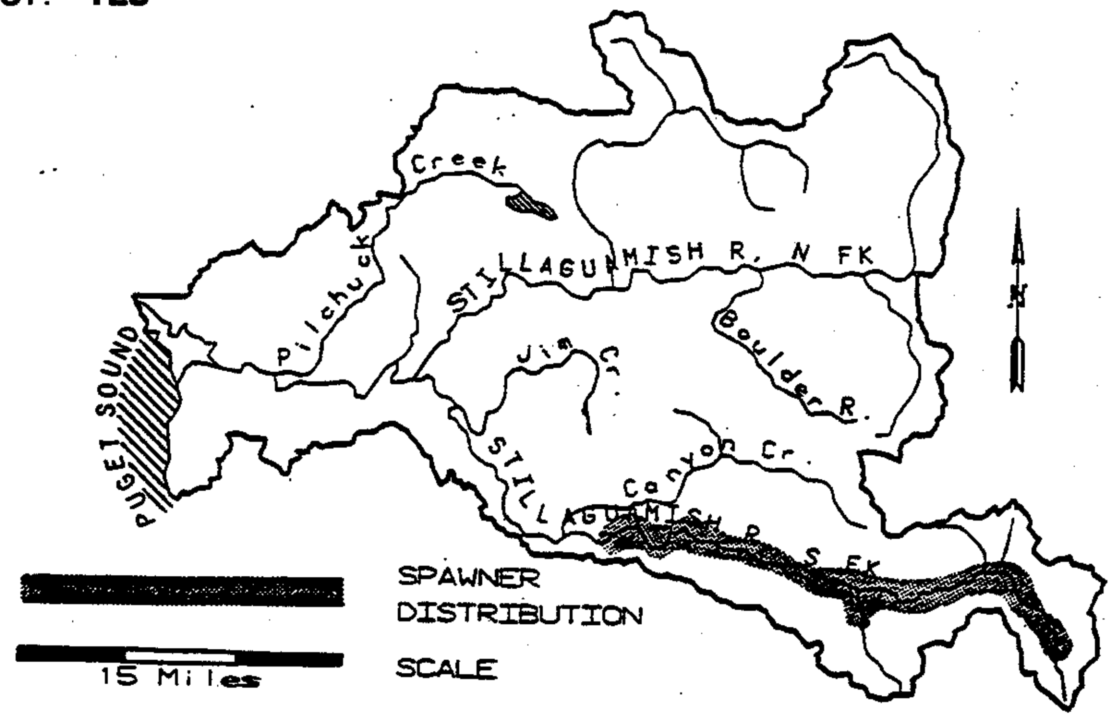
Habitat -- Land slides in Gold Basin and elsewhere in the basin affect the quality of the habitat in the basin. The habitat in the uppermost part of the basin remains good. The habitat in the basin became available to the steelhead with the construction of the fish ladder in the mid-1950s.

Harvest Management -- The wild steelhead release and the winter closure (sanctuary) protects these fish during the sport fishery. These fish would be vulnerable to poaching by sport fishermen and to incidental harvest in the Stillaguamish River and nearby marine waters during commercial salmon seasons.

Hatchery -- Hatchery fish were the source for this stock of steelhead.

STOCK DEFINITION PROFILE for SF Stillaguamish Summer Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY					■	■	■	■	■	■			**NO**
SPAWNING	■	■	■	■									**NO**

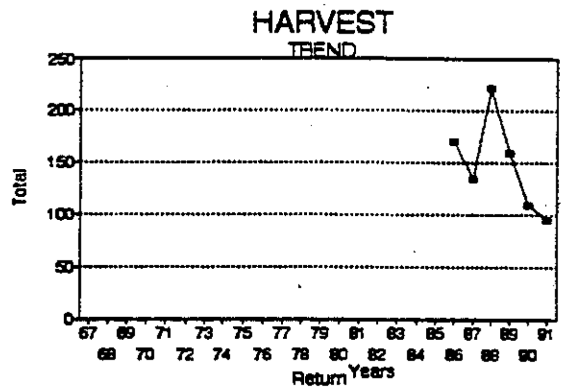
BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for SF Stillaguamish Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY-----> Fair

Return Years	HARVEST Total			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86	171			
87	135			
88	222			
89	160			
90	110			
91	96			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Non-Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Spawning Distribution

STOCK STATUS

Unknown

SCREENING CRITERIA

STILLAGUAMISH -- CANYON CREEK SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in Canyon Creek are a distinct stock based on the geographical isolation of the spawning population. This stock uses primarily the forks of Canyon Creek for spawning and early rearing. Wild summer steelhead are a mixture of native and non-native stocks since there is a high probability that this stock has hybridized with hatchery summer steelhead stocks.

Run-timing is generally from early June through October. Spawn-timing is unknown, but is believed to be similar to other wild summer steelhead stocks in the Puget Sound area (February through April).

STOCK STATUS

The status of the stock is Unknown. This stock is comprised of a historically small number of steelhead, but there is insufficient information to classify its status as either a Healthy, Depressed, or Critical stock.

Spawning escapement is not monitored for this stock nor has an escapement goal been identified.

Sport harvest data are available for many years, but wild summer steelhead were not reported separately on steelhead permit cards until the 1986 summer steelhead season. Sport harvest data of wild summer steelhead are available over the entire run, but wild sport harvest is too low to be used to assess the status of the wild stock.

More information needs to be collected on this stock so that stock status can be determined. As a small stock, it could be especially vulnerable to any negative impacts.

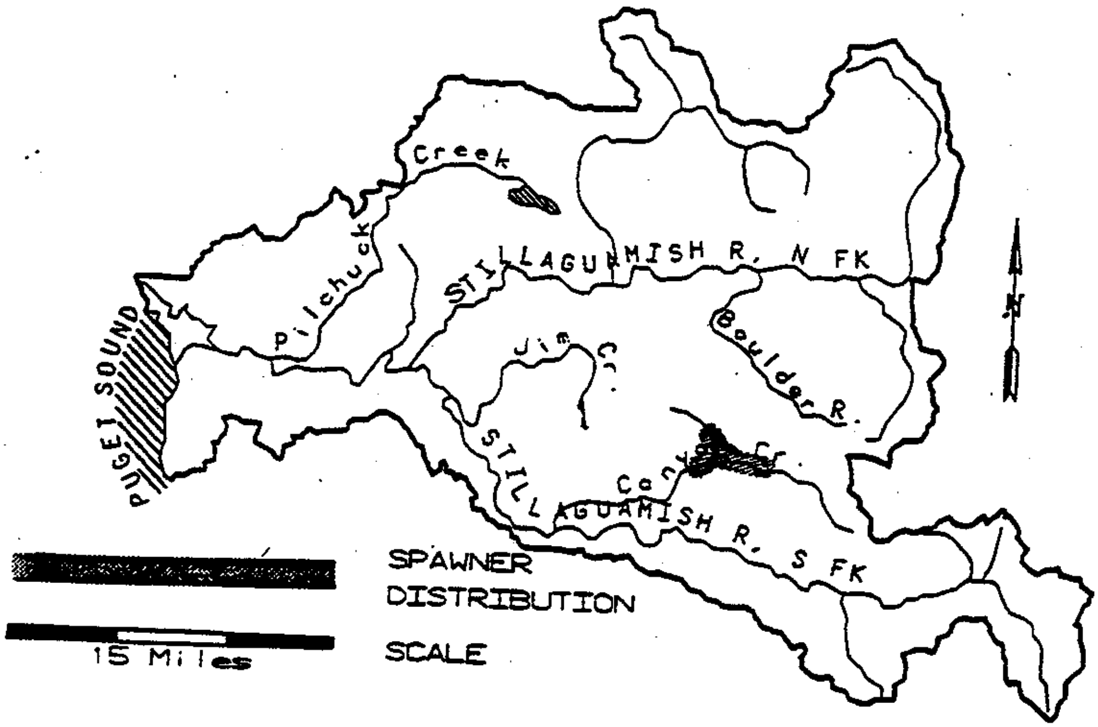
FACTORS AFFECTING PRODUCTION

Habitat -- Canyon Creek is another basin where habitat has been severely degraded by land management activities. Excessive bedload movement has degraded both spawning and rearing habitats and caused elevated stream temperatures. This habitat loss is the prime limiting factor.

Harvest Management -- Incidental harvest of this stock has occurred in the sport fishery. With wild fish release requirements beginning in 1992, this will be reduced, but some hook-and-release mortality may occur. There is no directed tribal fishery on this stock, but some harvest of wild steelhead may occur in other tribal salmon and/or steelhead fisheries.

STOCK DEFINITION PROFILE for Canyon Cr Summer Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													
SPAWNING													NO
													UNK

BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for Canyon Cr Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Fair

Return Years	HARVEST Total			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86	7			
87	9			
88	22			
89	2			
90	4			
91	15			

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Mixed

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

Hatchery -- While hatchery summer steelhead smolts have been stocked, contribution to the wild stock from hatchery fish spawning in the wild is unknown. There is a high probability that this stock has hybridized with hatchery summer steelhead stocks.

STILLAGUAMISH -- STILLAGUAMISH WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the mainstem Stillaguamish River, North Fork Stillaguamish River, South Fork Stillaguamish River, Pilchuck Creek, Jim Creek, Canyon Creek, and other tributaries are a distinct stock based on the geographical isolation of the spawning population. Run-timing of late November through April and spawning timing of mid-March through July is typical of many of the Puget Sound winter steelhead stocks.

This stock is of native origin. While there has been a long-term enhancement effort in the basin with the early-spawning Chambers Creek winter stock, there is little evidence of impacts on the native stocks by the introduced hatchery stocks.

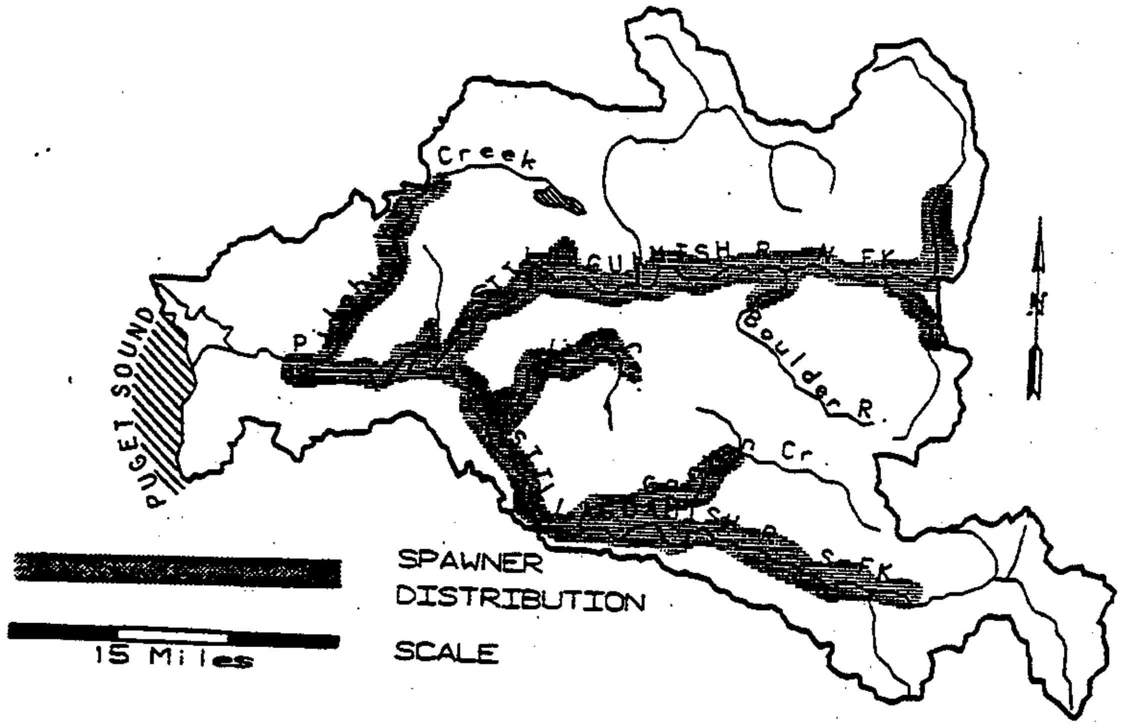
STOCK STATUS

The status of the stock is Healthy.

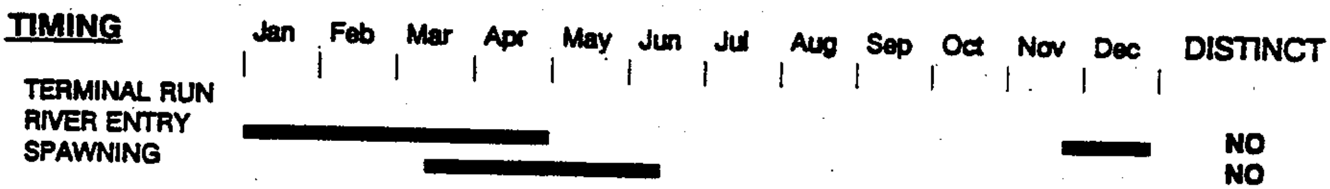
High turbidities in the South Fork caused by natural clay banks and turbidities in Canyon Creek and Deer Creek caused by unstable soils and land management activities (logging) limit spawning in the lower portion of the basin. Because of the turbid conditions, only index escapement information is available. The North Fork and tributaries upstream of Deer Creek are used as an index for the wild winter steelhead escapement. Using the methodology developed by Gibbons et al. (1985), an MSH escapement goal for this index section would be 950 wild winter steelhead. This goal has been met or exceeded every year it has been measured starting in 1985.

STOCK DEFINITION PROFILE for Stillaguamish Winter Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

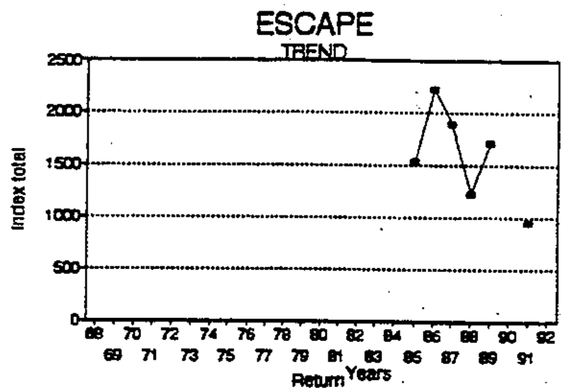
STOCK STATUS PROFILE for Stillaguamish Winter Steelhead

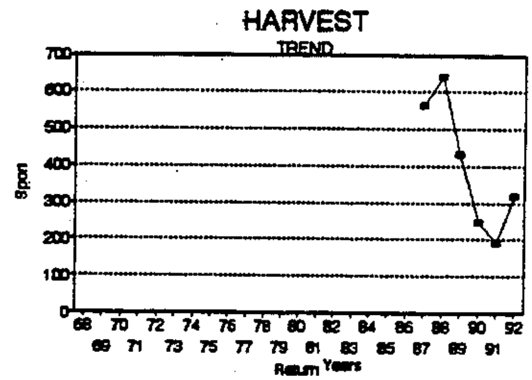
STOCK ASSESSMENT

DATA QUALITY——> Fair

Return Years	ESCAPE Index total	HARVEST Sport		
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85	1542			
86	2226			
87	1892	565		
88	1222	640		
89	1716	432		
90		250		
91	950	194		
92		319		

Escapement Goal in Index=950





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Spawning Distribution

STOCK STATUS

Healthy

SCREENING CRITERIA

OVERVIEW -- SNOHOMISH CHINOOK STOCKS

SNOHOMISH SUMMER **SNOHOMISH FALL**
WALLACE RIVER SUMMER/FALL **BRIDAL VEIL CREEK FALL**

STOCK DEFINITION AND ORIGIN

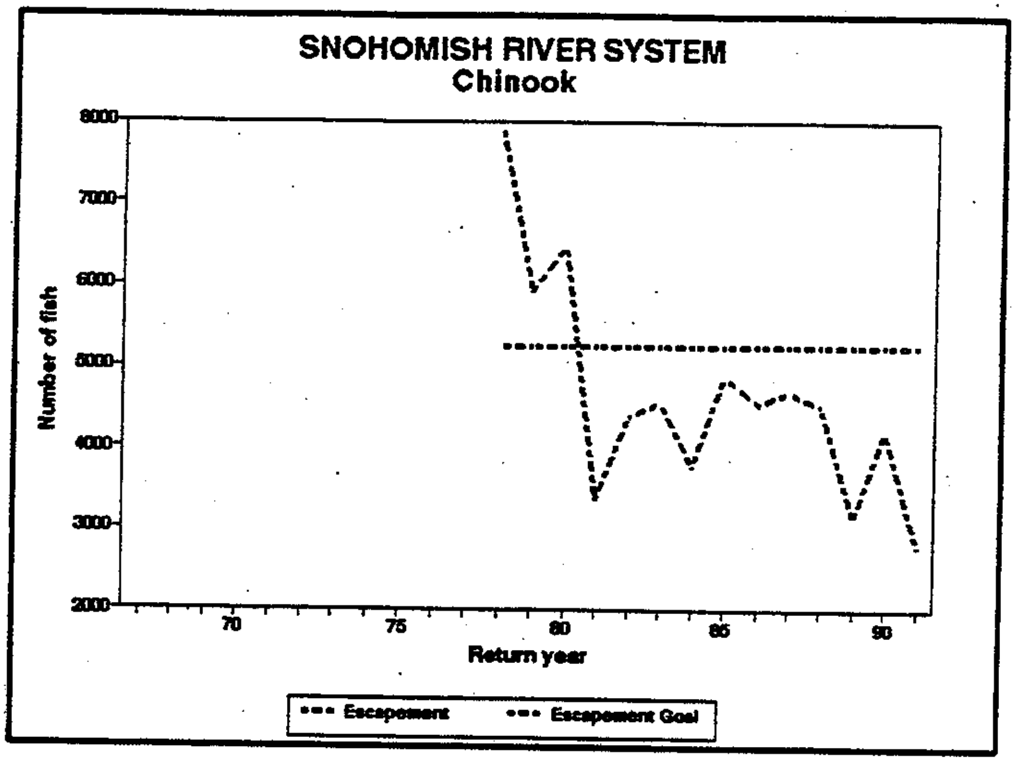
The natural spawning populations of chinook within the Snohomish system were separated into four distinct stocks: Snohomish summer chinook, Snohomish fall chinook, Bridal Veil Creek fall chinook and Wallace River summer/fall chinook. These stocks were defined based upon differences in spawn timing, spawning distribution and genetic composition. The Snohomish summer chinook spawn primarily in September, while the Snohomish fall and Bridal Veil chinook spawn primarily from late September through October. Wallace River chinook spawn throughout September and October.

All of these stocks have genetic baselines which show significant differences from one another with the exception of Wallace River chinook. The genetic baseline for Wallace River chinook is not statistically different from the baselines of any of the other Snohomish chinook stocks. Wallace River chinook demonstrate a prolonged spawning time (September through October) and spawn downstream of the Snohomish Hatchery, a facility that has both a summer and a fall chinook program. For these reasons, Wallace River chinook are thought to be a mixture of summer and fall fish of hatchery origin.

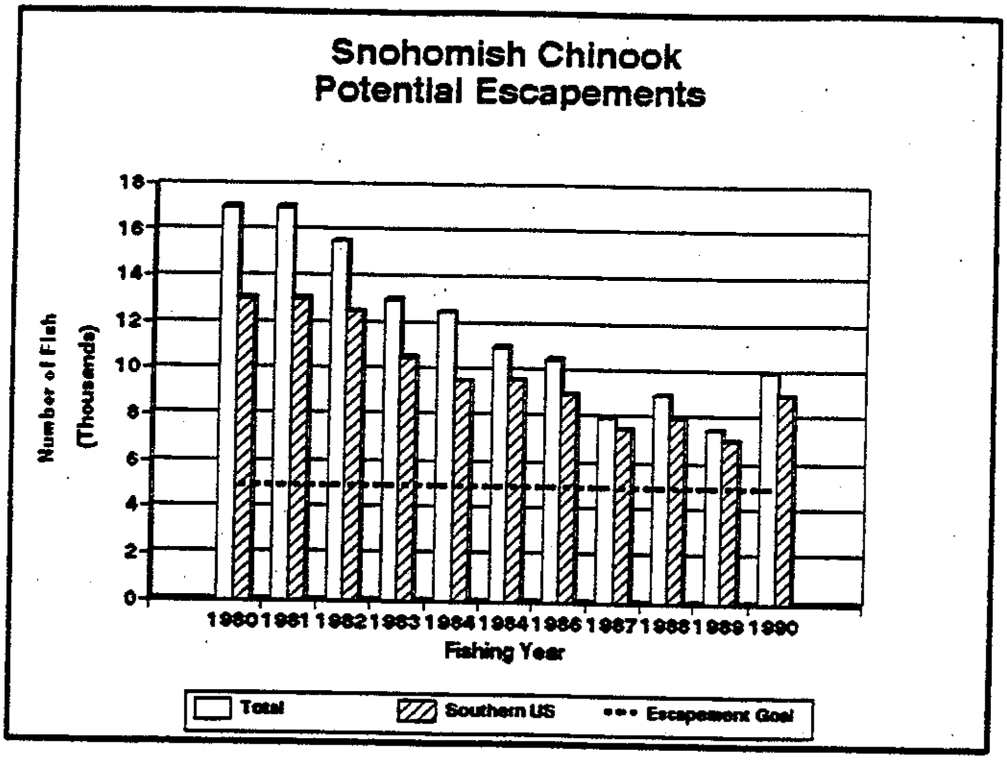
There is still uncertainty regarding a possible subdivision of Snohomish fall chinook into Sultan and Snoqualmie stocks. The genetic baselines for each of these areas indicate that these stocks differ from one another at one locus. Additional sampling of the Snoqualmie chinook may provide the information necessary to clarify whether these two areas contain distinct populations without significant genetic exchange. Analysis of scale patterns to determine differences in out-migration strategies will also be carried out on chinook spawning in the Sultan and Snoqualmie rivers.

STOCK STATUS

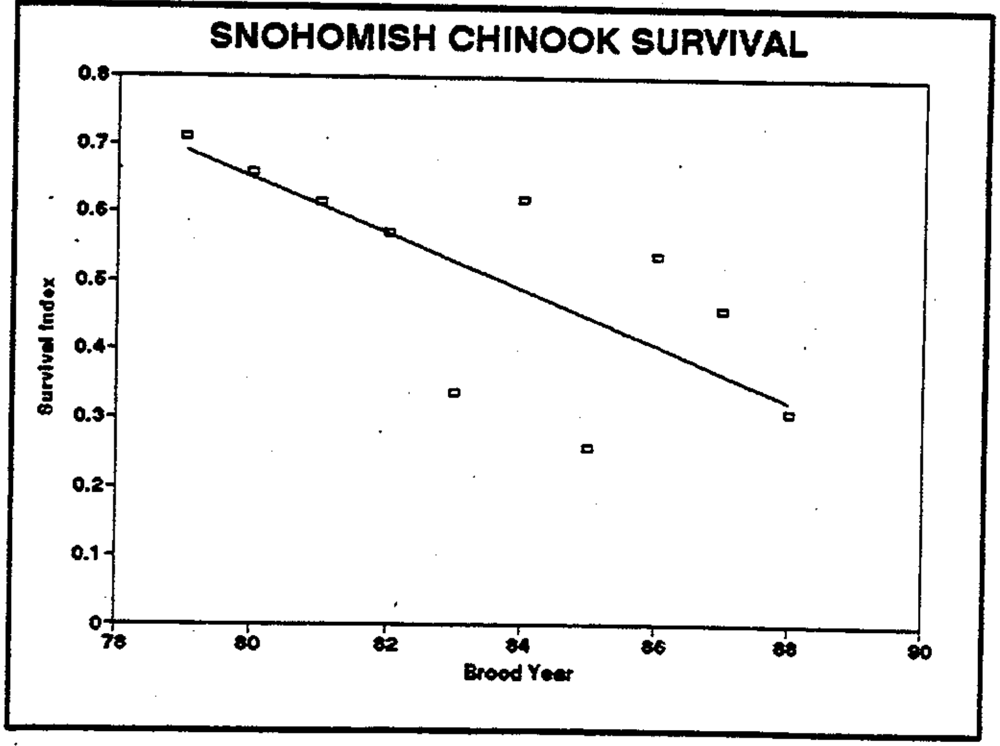
Snohomish chinook are managed as a single unit. The escapement goal for natural spawners is 5,250 fish per year. Escapement levels for the system have been below the goal since 1981. Escapement levels have remained between 3,000 to 5,000 until 1991 and 1992 when escapements dropped below 3,000 for the first time since the database was established (see figure).



The following figure (Puget Sound Salmon Stock Review Group, 1992) shows Snohomish chinook potential escapements assuming no fisheries on this run in Alaska and Canada or in the lower 48 states. The escapement goal is 5,250 adult chinook. Run-size estimates of Snohomish chinook entering Puget Sound have shown a steady decline since 1981. During these years, additional Puget Sound harvest constraints have been initiated which have prevented escapements from experiencing a similar declining trend. However, the recent drop in escapements seen in 1991 and 1992 may signal the start of a declining pattern of escapement similar to that seen in the run size estimates. The decrease in run-size is thought to be due to declining survival in these fish.



Snohomish chinook potential escapements assuming no fisheries on this run in Alaska and Canada (solid bars) and no fisheries in the U.S. lower forty-eight states (hatched bars).



Distribution of fishing mortality for Snohomish chinook is shown in the table below. The greatest impacts are in Canadian fisheries and in Puget Sound net fisheries.

More information on each stock is presented in separate Stock Reports.

Distribution of adult equivalent fishing mortality for Snohomish summer/fall chinook. From the Puget Sound Salmon Stock Review Group, 1992.

Brood	Alaska All	Canada All	PFMC Spt/Tr	Troll	Puget Sound North Net[4]	Puget Sound Other Net	Sport
1980	2	47	0	0	1	7	26
1981	23	70	0	0	1	7	10
1982	0	135	0	0	11	13	48
1983	14	75	0	0	0	12	30
1986[1]	0	178	0	19	4	32	86
1987[2]	5	300	0	30	9	37	52
1988[3]	0	34	0	0	0	28	3
Total 1980-86	39	505	0	19	17	71	200
Percent	4.6%	59.3%	0.0%	2.2%	2.0%	8.3	23.5

[1] Incomplete brood; ages 2 through 4 included in analysis.

[2] Incomplete brood; ages 2 and 3 included in analysis.

[3] Incomplete brood; age 2 included in the analysis.

[4] North net includes the Strait of Juan de Fuca, the San Juan Islands and the Blaine/Cherry Point area.

SNOHOMISH -- SNOHOMISH SUMMER CHINOOK

STOCK DEFINITION AND ORIGIN

This stock has been defined as a distinct stock based upon differences in spawning time and a partial difference in geographical distribution. The Snohomish summer chinook spawn in September and are distributed in the mainstem Snohomish and mainstem Skykomish River (to the forks) and associated tributaries. The spawn timing differs from the other two native stocks in the watershed. Both Snohomish fall chinook and Bridal Veil Creek chinook spawn primarily in October. The spawn timing does overlap with the early timing component of Wallace River chinook which are considered to be hatchery strays, however the Snohomish and Wallace stocks are considered to be distinct from one another. The spawning distribution differs from other chinook stocks in the Snohomish system, but mixing with the other stocks (especially Wallace River) could occur as the Wallace River chinook must pass through the spawning area of the Snohomish summer chinook.

Stock origin is considered to be native. It is not known whether other stocks may have influenced the genetic composition of this stock. The genetic baseline (1989) for Snohomish summer wild chinook is not different from the Skykomish hatchery summer chinook stock genetic baseline (1987-1988). Snohomish summer chinook are distinct from all other Snohomish system stocks with the exception of Wallace River chinook.

STOCK STATUS

Stock status is Depressed based upon chronically low escapement levels.

Escapement estimates, which utilize redd counts, averaged 1,661 from 1979-1991 and remained stable during that period. However, the combined escapement level of the summer and fall chinook in this system has been under the escapement goal of 5,500 since 1981.

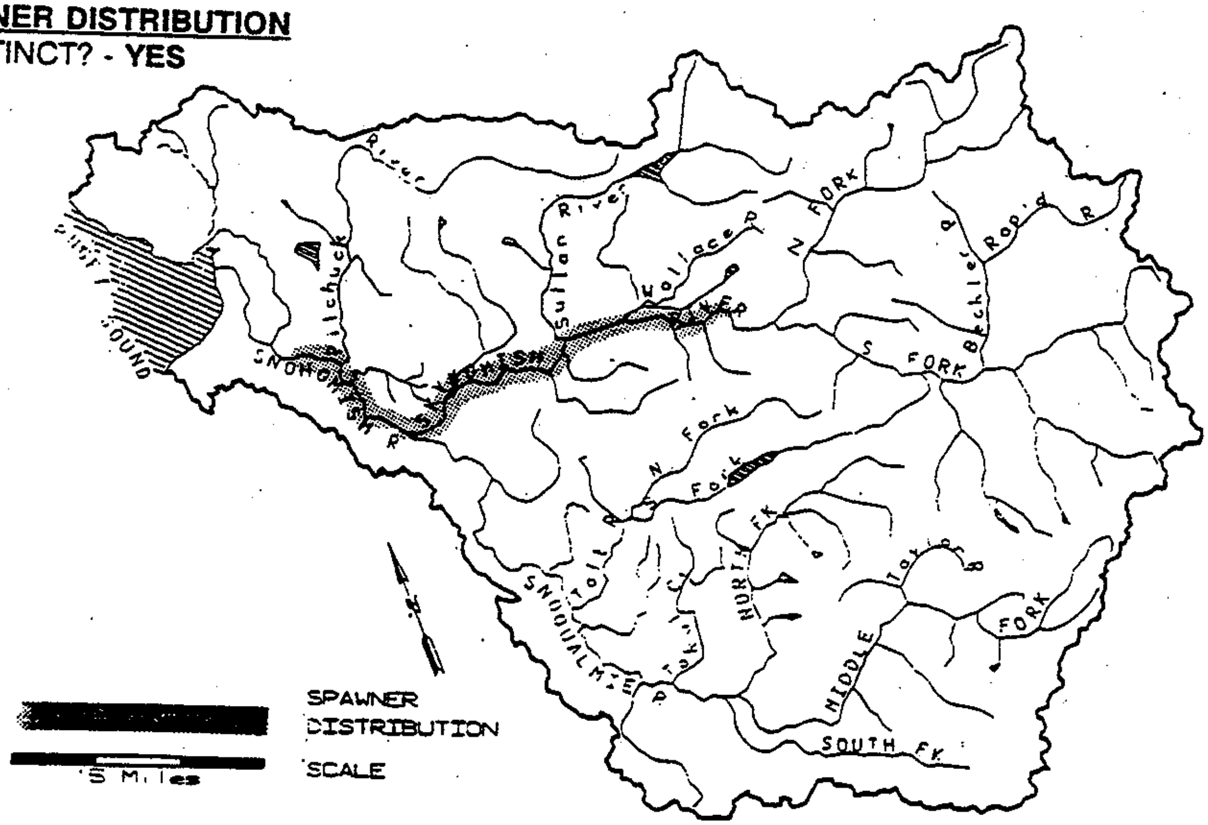
A WDFW hatchery on the Skykomish River produces summer chinook. In recent years, hatchery production has declined, and the future of the program is uncertain at this time.

FACTORS AFFECTING PRODUCTION

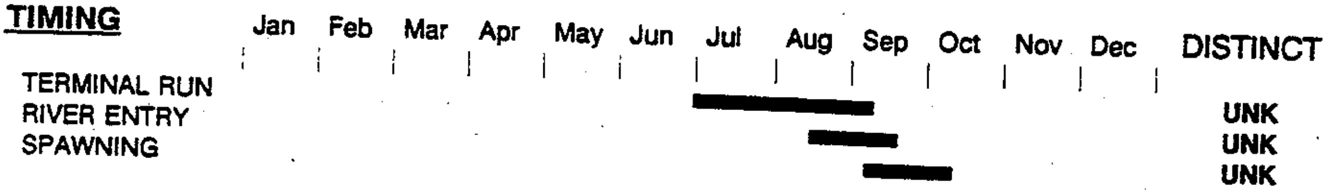
Habitat - Historical and continuing habitat problems exist in the mainstem Snohomish River and Port Gardner due to agricultural diking and industrial pollution. The river also lacks large woody debris, due to extensive land clearing and lacks a source of new trees to provide large woody debris in the future due to logging and conversion of forests to agricultural and suburban uses. Gravel removal is permitted in the mainstem, however it is not known if this activity affects summer chinook.

STOCK DEFINITION PROFILE for Snohomish Summer Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

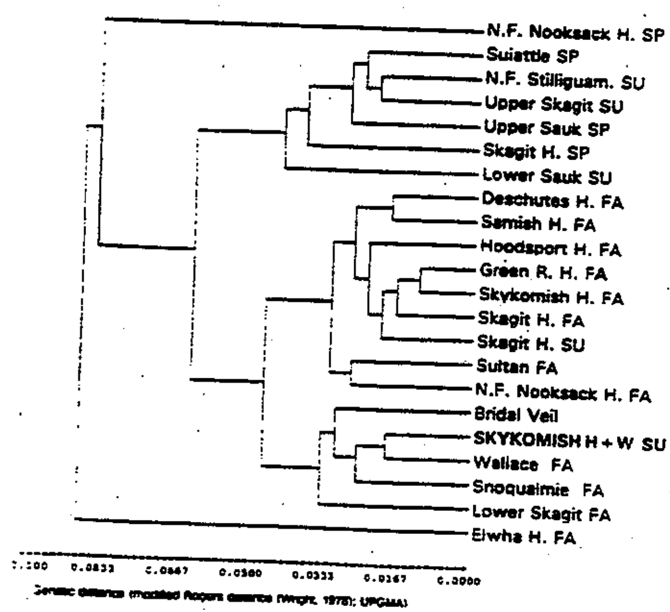


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Genetic data exist for Skykomish hatchery (1987 & 1988) and wild (1989) summer chinook, and they were combined to form the baseline for the stock. Skykomish summers are distinct ($p < 0.05$) from all other Puget Sound stocks examined.



STOCK STATUS PROFILE for Snohomish Summer Chinook

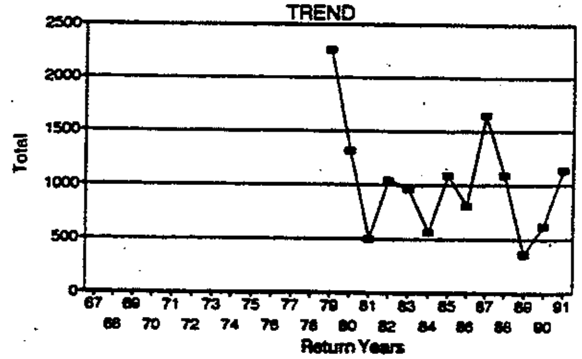
STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79	2258			
80	1318			
81	500			
82	1045			
83	963			
84	560			
85	1093			
86	815			
87	1650			
88	1093			
89	361			
90	623			
91	1142			

ESCAPE

TREND



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Timing

STOCK STATUS
Depressed

SCREENING CRITERIA
Chronically Low, LT Neg Trend

Harvest Management --

Preterminal Fisheries - Snohomish River chinook are caught in fisheries in Alaska and Canada and in the following preterminal fisheries in U.S. waters: Strait of Juan de Fuca (Areas 4B, 5 and 6C) sport, net and troll fisheries, Fraser River sockeye/pink-directed net fisheries in the Strait of Juan de Fuca, the San Juan Islands (Area 7) and the Boundary Bay - Cherry Point area (Area 7A), and sport fisheries in the eastern Strait of Juan de Fuca (Area 6), Deception Pass - Saratoga Pass (Area 8) and Admiralty Inlet (Area 9).

Terminal Fisheries - Snohomish chinook are managed to meet natural escapement and production needs in the terminal and extreme terminal areas.

In addition to being caught in preterminal fisheries, Snohomish chinook are also caught in coho-directed net fisheries near Seattle (Area 10), Port Gardner (Area 8A) and Tulalip Bay vicinity (Area 8D) and the Snohomish River, and in sport fisheries in Port Gardner, Saratoga Pass, and the Snohomish, Snoqualmie and Skykomish rivers.

The Puget Sound Salmon Stock Review Group examined catches of Snohomish summer/fall chinook (no distinction was made between summer and fall run chinook). The results are available in their Overfishing Report prepared for the Pacific Fisheries Management Council (1992). The report indicates that for the 1980-1990 broods, fisheries in Canada accounted for nearly 50% of the Snohomish summer/fall chinook fishing mortality. Net fisheries in Puget Sound took nearly 41% of the Snohomish chinook catch. Net fisheries in Alaska, the Strait of Juan de Fuca, the San Juan Islands and Area 7A totaled about 3% of the total catch, and sport fisheries in Puget Sound took approximately 8% of the total catch.

The maximum sustained harvest rate for Snohomish chinook is estimated at 62% (Puget Sound Salmon Stock Review Group 1992). The average adult equivalent exploitation rate from 1980-1990 was 70% (range 57% to 79%). The exploitation rate has dropped since institution of Pacific Salmon Commission management in 1985.

Hatchery -- Hatchery operational impacts have not been determined. Summer chinook have been reared at the Skykomish hatchery located on the Wallace River. This hatchery also produces fall chinook and coho.

Last ten years salmon releases into the Snohomish basin.

Release Year	Summer Chinook	Fall Chinook	Chum	Coho	Pink
1982	684567	2131851	1280000	584729	38125
1983	1377898	1069000	800000	700900	0
1984	148500	1581200	1843000	3019697	0
1985	632900	1035000	6598000	1895463	0
1986	616300	2609750	2500000	2069447	168480
1987	398200	1057660	260300	2377065	0
1988	227900	2960500	0	1443052	207000
1989	201000	992500	5800000	1349218	0
1990	1252600	1926870	5800000	1758273	0
1991	212000	2257314	4400000	2259598	0
MEAN	575187	1762165	3253478	1745744	137868

SNOHOMISH -- WALLACE RIVER SUMMER/FALL CHINOOK

STOCK DEFINITION AND ORIGIN

This stock is not genetically different from the Skykomish hatchery or other Snohomish wild summer/fall stocks with the exception of a slight difference from the Snoqualmie stock. Wallace River chinook are considered to be a mixture of stocks resulting from hatchery straying. Wallace River chinook are listed as a separate stock because they are less genetically distinct than Snohomish system summer/fall chinook and other Snohomish chinook stocks. The spawn timing of Wallace River chinook overlaps with both summer and fall chinook. The geographical distribution extends from the mouth of the Wallace River to the Skykomish Hatchery rack.

The stock origin is a hybrid of hatchery stocks (and possibly wild stocks) including Green River fall chinook.

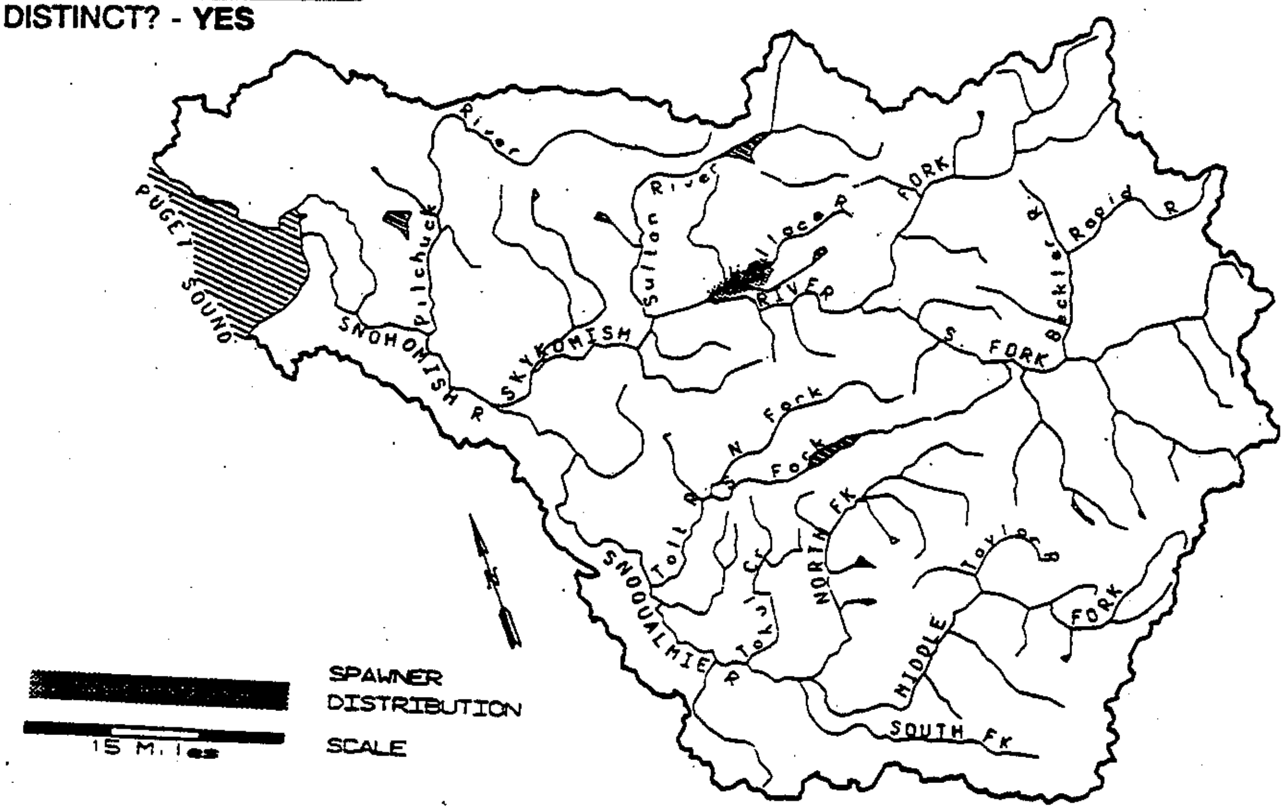
STOCK STATUS

The status of the stock is Healthy based on trends in spawning escapement.

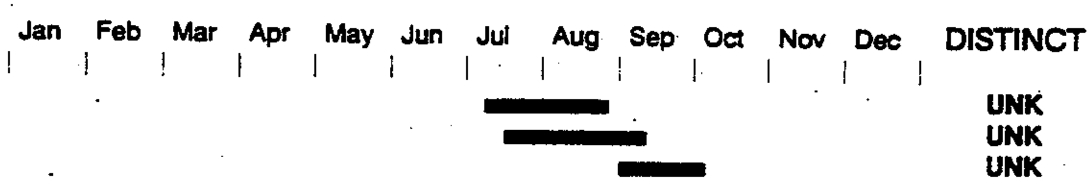
The stock is sustained by both wild and hatchery production. Escapement levels have averaged 1,015 from 1979 to 1991 and have shown a negative trend since 1986. This negative trend is probably related to decreased hatchery releases into the Wallace River during the same time frame.

STOCK DEFINITION PROFILE for Wallace Summer/Fall Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

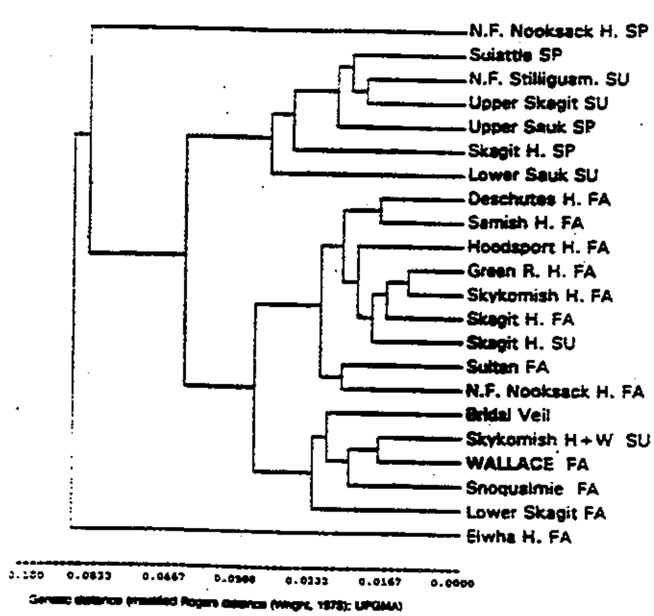


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **NO**

GENETICS - The genetic characteristics of Wallace River chinook sampled in 1989 were not significantly different (p>0.05) from several Skykomish system summer and fall stocks, including Skykomish Hatchery and wild summer stocks. This result supports the suggestion that Wallace spawners include hatchery strays from other Skykomish stocks.

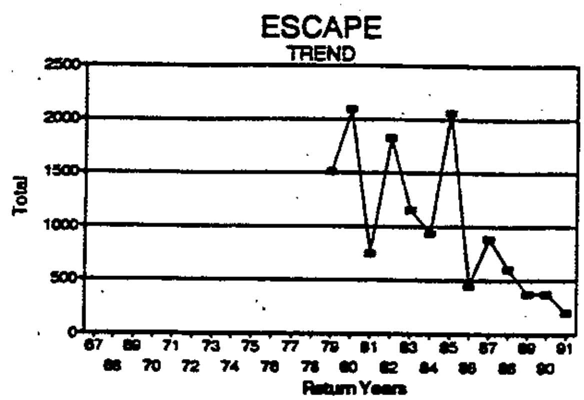


STOCK STATUS PROFILE for Wallace Summer/Fall Chinook

STOCK ASSESSMENT

DATA QUALITY<-----> Good

Return Years	ESCAPE Total			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79	1513			
80	2085			
81	748			
82	1823			
83	1155			
84	940			
85	2055			
86	445			
87	885			
88	607			
89	373			
90	370			
91	200			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Mixed

PRODUCTION TYPE

Composite

STOCK DISTINCTION

Distribution

STOCK STATUS

Healthy

SCREENING CRITERIA

SNOHOMISH -- SNOHOMISH FALL CHINOOK

STOCK DEFINITION AND ORIGIN

Snohomish fall chinook spawn from mid-September through October, differing in timing from the Snohomish summer chinook. Spawning occurs in the Snoqualmie River, Sultan River, Pilchuck River, Woods Creek and Elwell Creek.

Genetic baselines for Sultan fall chinook and Snoqualmie fall chinook are different at only a single locus. Therefore, these fish are considered part of the Snohomish fall chinook stock, pending clarification of their genetic relationship to the remainder of the Snohomish fall stock. Snohomish fall chinook are genetically distinct from Snohomish summer, Skykomish hatchery fall and Bridal Veil Creek fall chinook.

Snohomish fall chinook are native and genetically distinct from Skykomish hatchery fall chinook, suggesting that hybridization between these stocks has been inconsequential even though they share similar run timing within the same system. The genetic differences between the native Snohomish fall chinook and Skykomish hatchery chinook indicate that the hatchery chinook are not representative of the native stock. This conclusion is not surprising considering the Green River fall chinook introductions into the hatchery stock. The Skykomish hatchery fall chinook genetic baseline is not significantly different from those of the Skagit hatchery fall stock, the Skagit hatchery summer stock or the Green River hatchery fall stock.

STOCK STATUS

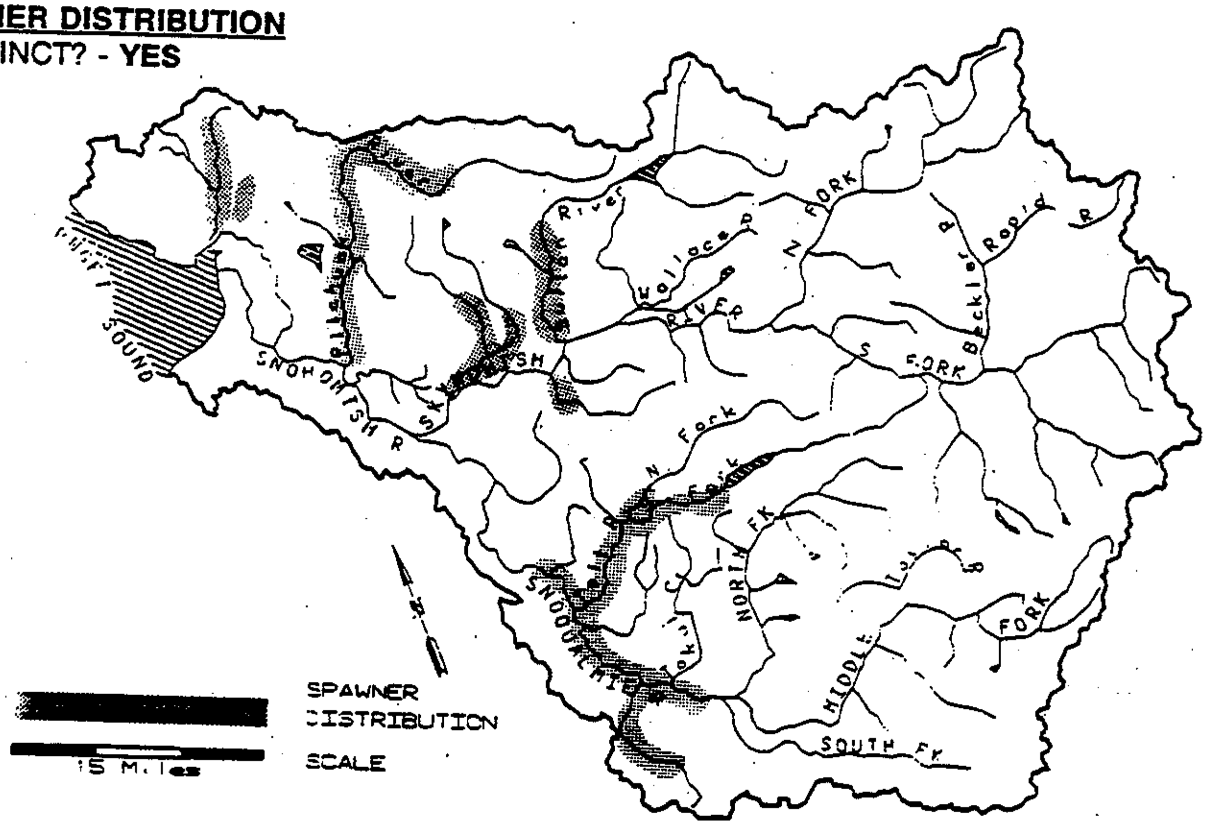
The status of the stock is Depressed based on chronically low escapement levels and run sizes entering Puget Sound which have shown a long-term negative trend since the 1970s.

Escapement levels are based upon redd counts or carcass counts and averaged 1,722 from 1979 - 1991 with a range of 900 to 2,600 fish. Coupled with the escapement levels from Snohomish summer chinook, total Snohomish chinook escapements have been below the escapement goal of 5,250 fish since 1981.

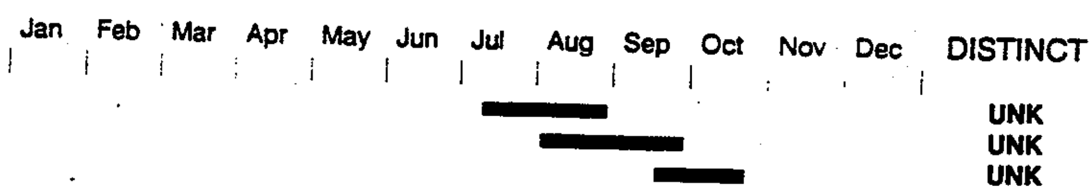
There is no supplementation program for this stock.

STOCK DEFINITION PROFILE for Snohomish Fall Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

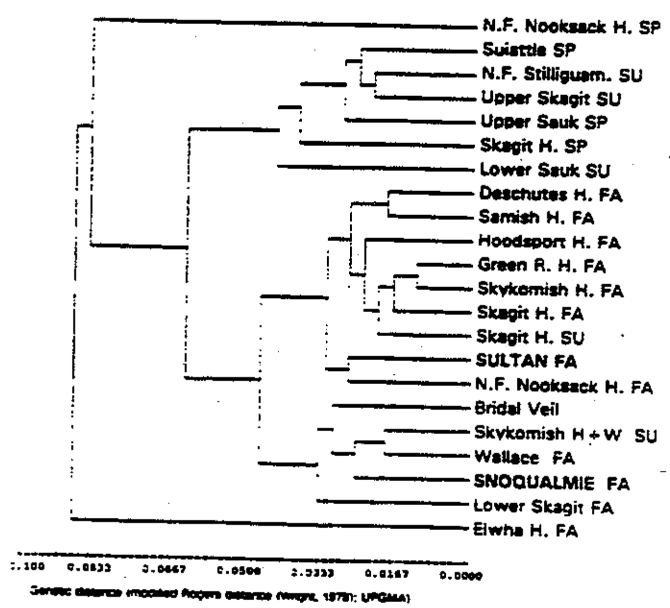


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Genetic data exist for Sultan (1987, 1988, & 1989) and Snoqualmie (1988) wild fall spawners. The Sultan and Snoqualmie chinook are genetically distinct from each other, and both are significantly different (**p**<0.05) from other Skykomish stocks and all other Puget Sound stocks examined.

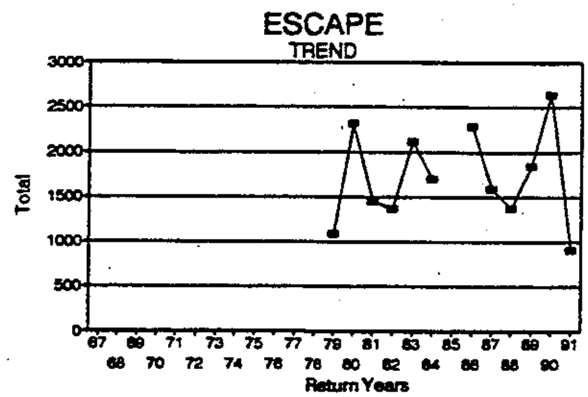


STOCK STATUS PROFILE for Snohomish Fall Chinook

STOCK ASSESSMENT

DATA QUALITY-----> Good

Return Years	ESCAPE Total			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79	1089			
80	2317			
81	1449			
82	1370			
83	2108			
84	1697			
85				
86	2287			
87	1587			
88	1376			
89	1840			
90	2635			
91	908			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Timing, Genetic

STOCK STATUS
Depressed

SCREENING CRITERIA
Chronically Low, LT Neg Trend

SNOHOMISH -- BRIDAL VEIL CREEK FALL CHINOOK

STOCK DEFINITION AND ORIGIN

This stock was defined as distinct based upon genetic analysis, geographical distribution and spawn timing. Genetic analysis demonstrates that Bridal Veil Creek chinook are different from all other Puget Sound chinook stocks examined to date. The geographical distribution of this stock includes Bridal Veil Creek, South Fork Skykomish between the forks and Sunset Falls (RM 49.6 to RM 51.1), the area above Sunset Falls and North Fork Skykomish from the forks to Bear Creek (RM 0.0 to RM 13.1). Fish returning to Sunset Falls are trucked above the falls and released. Spawning is in October with the peak of spawning in the second week of October. This timing is slightly later than the chinook stock in the mainstem Skykomish which is the closest stock geographically. Genetic analysis has been done only on fish in Bridal Veil Creek. Genetic definition is needed for the other fish included in this stock.

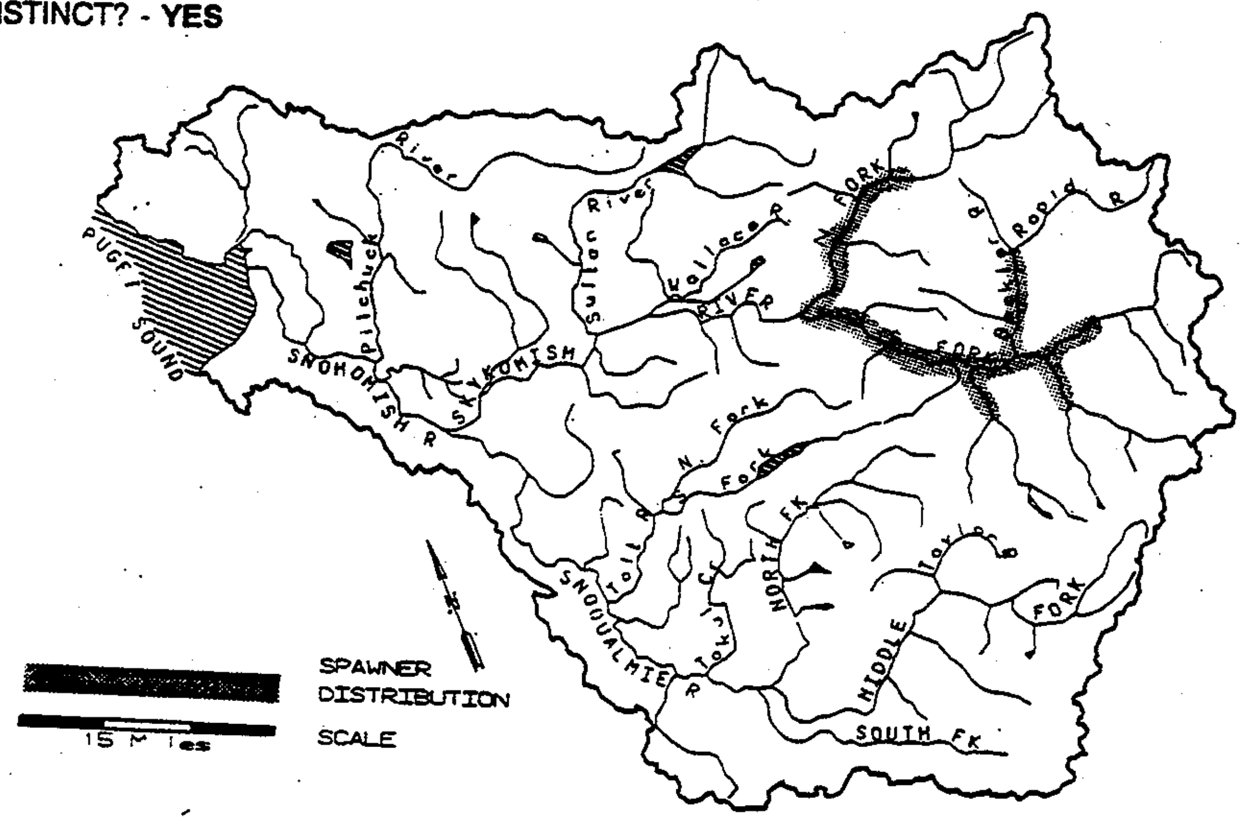
The stock origin is native, and spawning is natural. No supplementation program exists for this stock.

STOCK STATUS

The stock status is Unknown as spawning survey data are sparse and reflect only the range of spawn timing for a few years.

STOCK DEFINITION PROFILE for Bridal Veil Creek Fall Chinook

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

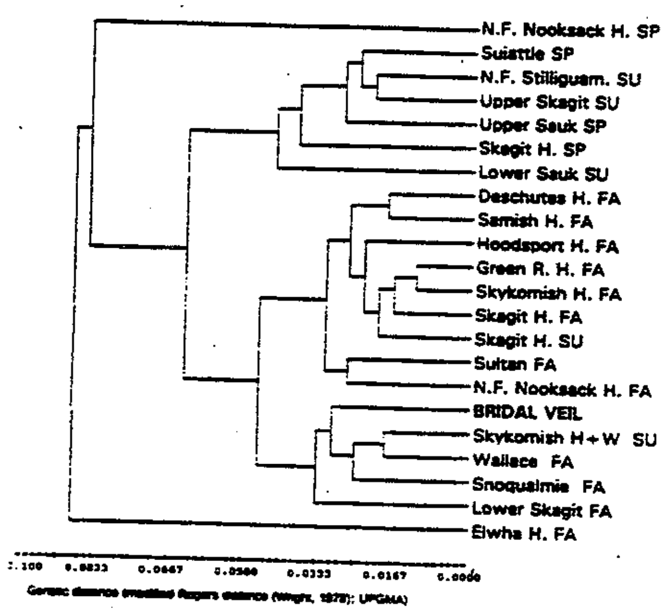


TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													UNK
RIVER ENTRY													UNK
SPAWNING										▬			YES

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Genetic data from Bridal Veil Creekwild spawners sampled in 1987-88 show them to be significantly different ($p<0.05$) from other Snohomish system stocks and from other Puget Sound stocks examined.



STOCK STATUS PROFILE for Bridal Veil Creek Fall Chinook

STOCK ASSESSMENT

DATA QUALITY-----> Unknown

Return Years	NO DATA			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Timing, Genetic

STOCK STATUS
Unknown

SCREENING CRITERIA

OVERVIEW -- SNOHOMISH FALL CHUM STOCKS

SKYKOMISH
SNOQUALMIE
WALLACE

STOCK DEFINITION AND ORIGIN

Chum salmon in the Snohomish are separated from other chum stocks geographically. Within the system, chum are tentatively divided into three stocks: Skykomish, Snoqualmie and Wallace. This division is based on geographic separation and possible genetic differences. Pilchuck River chum are tentatively included with the Skykomish chum, pending further investigation.

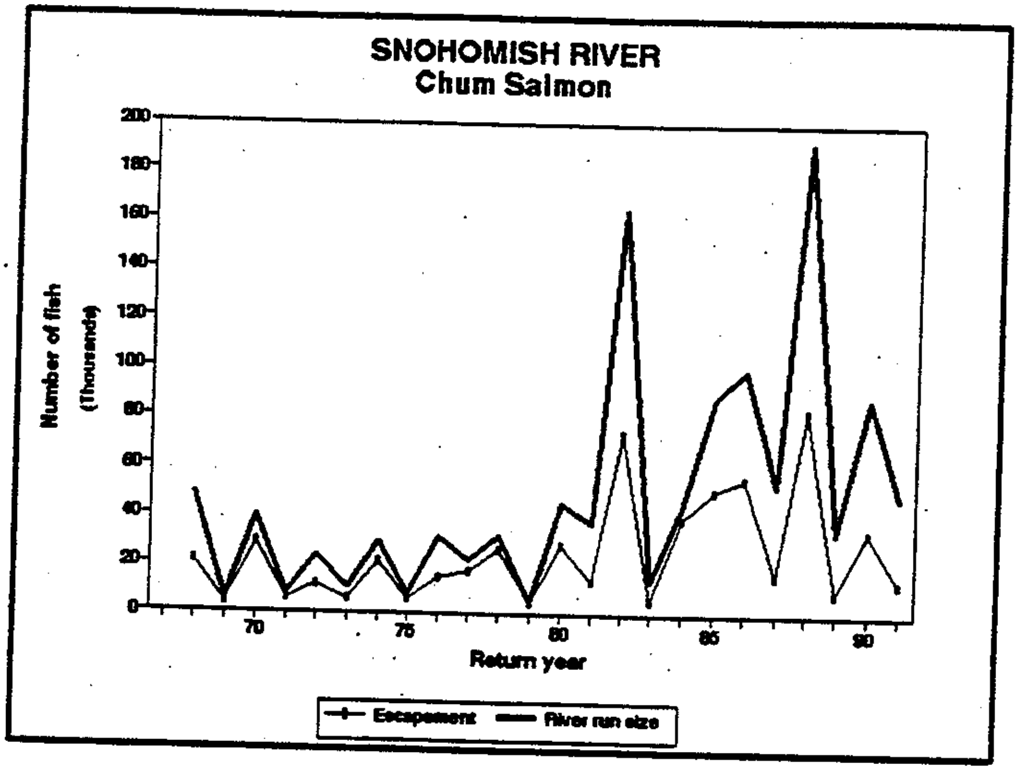
Entry timing of chum salmon in the Snohomish is probably similar to that in other northern Puget Sound rivers, primarily October through December with the peak around early to mid-November. Spawning occurs during November through December with the peak coming in early to mid-December.

Skykomish chum are considered to be of native origin. However, Grays Harbor and Hood Canal chum were introduced into the system via the Skykomish Hatchery. Genetic analysis has shown that Wallace chum are genetically distinct from other Puget Sound stocks although Wallace and Skykomish are similar to one another. Snoqualmie chum are currently being analyzed.

STOCK STATUS

The estimated annual return of Snohomish chum salmon over the last ten years has ranged from 44,000 to 190,000 for even-numbered years and 16,000 to 88,000 for odd-numbered years. Escapement estimates have ranged from 34,000 to 83,000 for even years and 6,600 to 51,000 for odd years (see figure). The difference in the ranges between odd- and even-numbered years may be due to competition with pink salmon which are present in much greater numbers in odd years than in even years. Total returns are calculated from escapement estimates and harvest data and do not included Canadian interceptions. Snohomish chum are taken in mixed stock fisheries in the Strait of Juan de Fuca and the San Juan Islands. They are targeted in Port Gardner/Port Susan (Area 8A) commercial and tribal net fisheries. They are also taken in saltwater and freshwater sport fisheries. Escapement estimates are based on a comparison of spawning ground counts in designated index areas with counts for the same areas made during 1977, when the escapement was determined by a tagging study. The accuracy of these figures is unknown, but they are useful for showing trends because of consistency in survey methods and personnel.

More information on each stock is presented in separate Stock Reports.


SNOHOMISH RIVER
Chum Salmon
200
180
160
140
120
100
80
60
40
20
0
Number of fish
(Thousands)
70
75
80
85
90
Return year
Escapement
River run size

SNOHOMISH -- SKYKOMISH FALL CHUM

STOCK DEFINITION AND ORIGIN

Skykomish chum are separated from other chum stocks geographically. Spawning in the Skykomish and its tributaries occurs during November and December with the peak coming in early to mid-December. Spawning occurs in the mainstem Skykomish from below Monroe (RM 24.0) upstream to at least Proctor Creek (RM 42.0). Small numbers of chum are trapped and transported above Sunset Falls (RM 52.0), but it is not known if they spawn successfully. The heaviest spawning is in the braided side channels from below Sultan to above Gold Bar (RM 33.0 to RM 41.0). Some spawning occurs in the Wallace and Sultan Rivers. Wallace chum are tentatively considered a separate stock and are discussed elsewhere.

Skykomish chum are considered to be of native origin. However, Grays Harbor and Hood Canal chum were introduced into the system via the Skykomish Hatchery. Genetic analysis has shown that Skykomish and Wallace chum are distinct but similar to one another. The relation between Skykomish chum and Snoqualmie chum is unknown but is being examined.

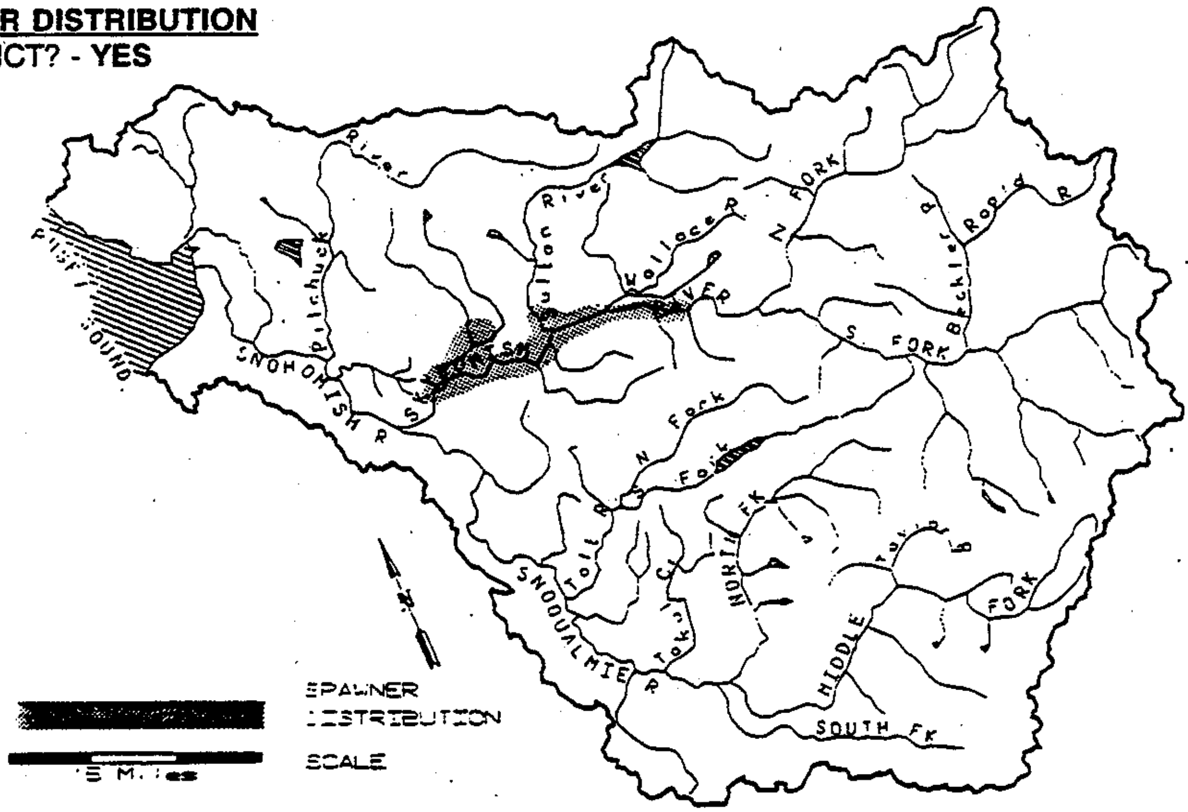
STOCK STATUS

The status of the stock is Healthy based on trends in spawning escapement.

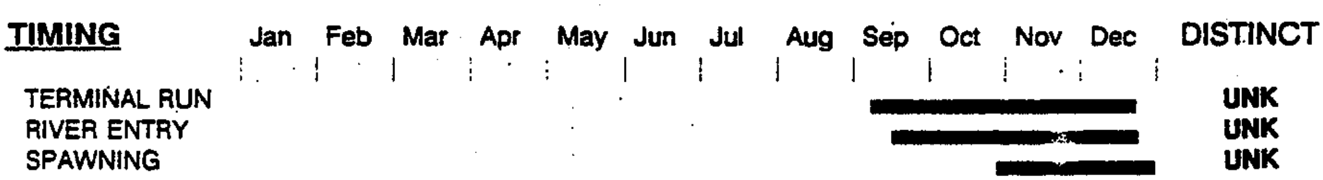
Escapement estimates are not normally generated for all components of the Snohomish run, however the Wallace index covers essentially all of that component of the run. Estimating the Wallace separately and subtracting it from the total Snohomish gives an estimate of the combined Skykomish and Snoqualmie components. Returns of the Skykomish component of Snohomish basin chum range from 38,000 to 150,000 in even-numbered years and from 14,000 to 76,000 in odd-numbered years. Escapements range from 5,400 to 44,000 in odd years and from 31,000 to 67,000 in even years. Though the Snoqualmie component is unknown, it is believed to be very small. Skykomish indices include various sloughs and side channels from below Sultan (RM 34.0) to Gold Bar (RM 42.0). Numbers should be suitable for showing trends.

STOCK DEFINITION PROFILE for Skykomish Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

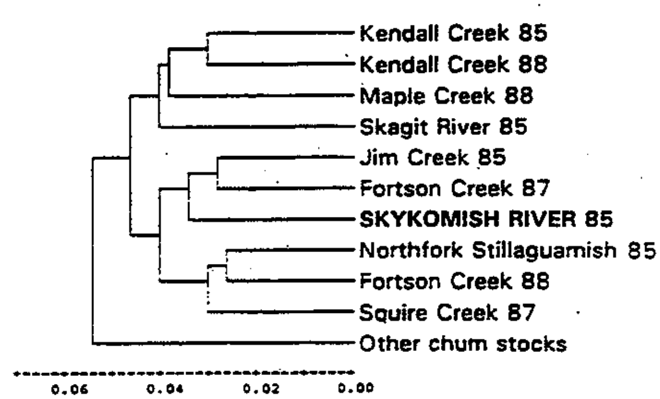


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - Fish from the Skykomish Slough were sampled for genetic analysis in 1985 (N=100). This collection is genetically distinct from, but closely related to Stillaguamish chum. This collection is significantly distinct (21-locus G-tests: **p** <0.05) from all other Washington and Canadian GSI collections from outside the Snohomish basin.



Genetic distance (modified Rogers distance (Wright,1978); UPGMA)

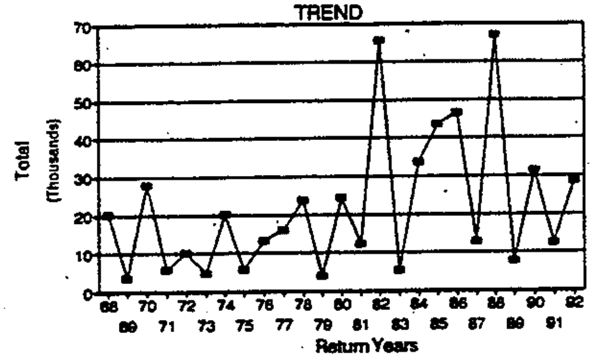
STOCK STATUS PROFILE for Skykomish Fall Chum

STOCK ASSESSMENT

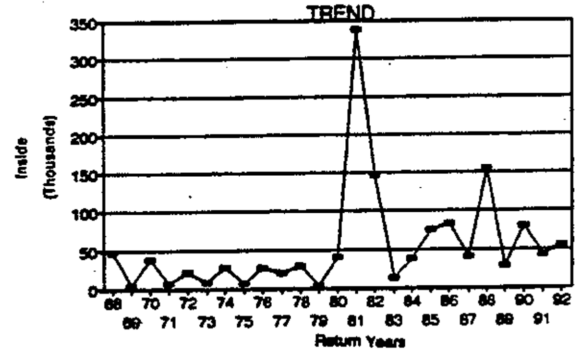
DATA QUALITY——> NOT AVAILABLE

Return Years	ESCAPE Total	RUNSIZE Inside		
68	20486	47502		
69	3575	4876		
70	27964	38252		
71	5769	7367		
72	10149	21994		
73	4855	9299		
74	20225	28345		
75	5769	7336		
76	13233	27265		
77	16046	20649		
78	23885	29559		
79	3853	4201		
80	24504	41042		
81	12349	338279		
82	65564	147311		
83	5386	13913		
84	33552	38092		
85	43600	76016		
86	46586	83930		
87	12864	41165		
88	67053	154983		
89	7822	29053		
90	31269	80434		
91	12413	43342		
92	28647	55824		

ESCAPE
TREND



RUNSIZE
TREND



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Genetics

STOCK STATUS
Healthy

SCREENING CRITERIA

SNOHOMISH -- SNOQUALMIE CHUM

STOCK DEFINITION AND ORIGIN

Separation of Snoqualmie chum salmon from other chum stocks is based on geography. Chum salmon spawning in the Snoqualmie is poorly documented but has been observed during December in a side channel near Fall City (RM 36.0) and in the Tolt River. It may occur in other places as well.

Snoqualmie chum are considered to be of native origin. However, Grays Harbor and Hood Canal chum were introduced into the system via the Skykomish Hatchery. Snoqualmie chum are being genetically tested to determine their relationship to other populations.

STOCK STATUS

The present status of Snoqualmie chum is Unknown.

There have been no spawning ground surveys directed toward chum in the Snoqualmie since 1977. Numbers of fish are believed to be small as incidental reports of chum in the system are few.

FACTORS AFFECTING PRODUCTION

Habitat -- Mainstem impacts are primarily from agricultural diking and sedimentation from logging in the upper watershed. This stock is probably also limited by loss of estuarine wetlands and degradation of nearshore habitat in Port Gardner (Beauchamp, Pflug and Lucchetti 1987).

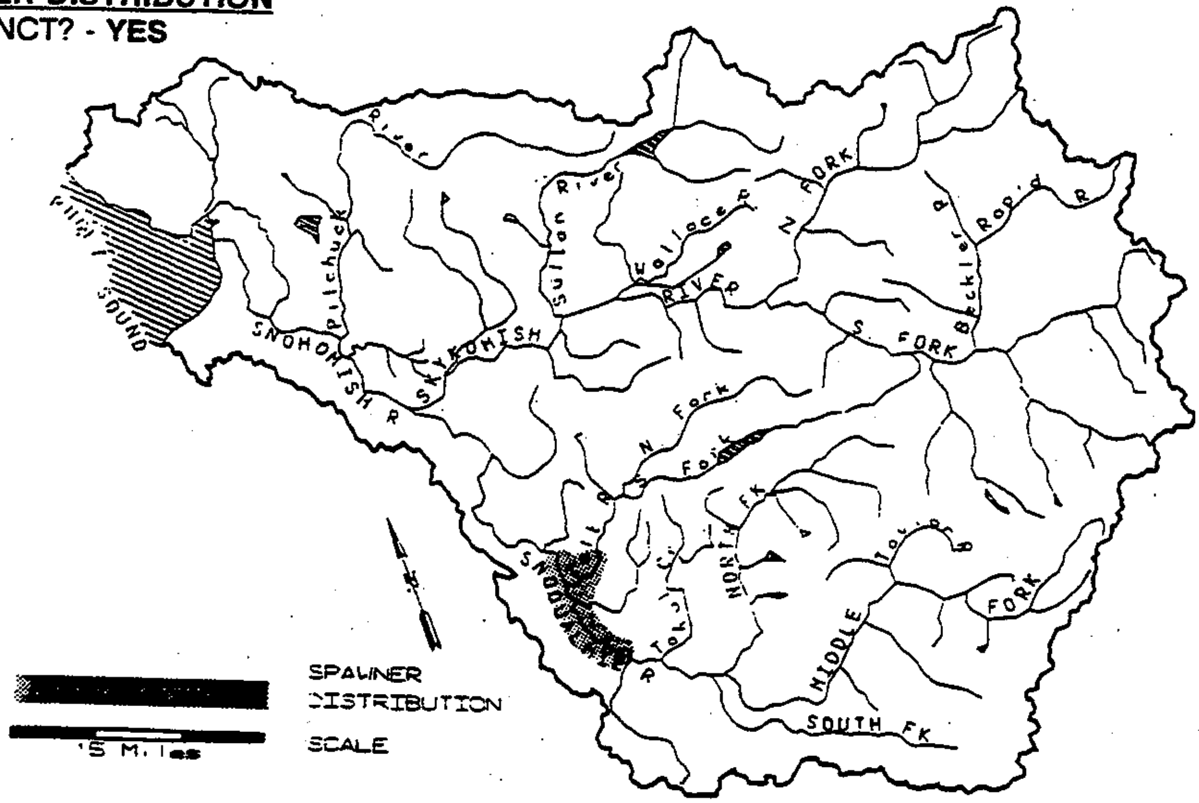
Harvest Management -- Snoqualmie chum are harvested in Canadian and American preterminal fisheries and terminal fall chum commercial net fisheries in the Strait of Juan de Fuca (Area 4B, 5 and 6C), the San Juan Islands (Areas 6, 7 and 7A), Admiralty Inlet (Area 9) (prior to 1989), Port Gardner/Port Susan (Area 8A) and near Seattle (Area 10). Terminal net fisheries impacting this stock in the Port Gardner/Port Susan area (Area 8A), the Tulalip Bay vicinity (Area 8D) and the Snohomish River are managed at the exploitation rate necessary to achieve the natural escapement goal for all wild Snohomish stocks in aggregate. Therefore, estimates of fisheries impacts on individual components of the Snohomish basin run are not made except under special circumstances.

Preterminal Fisheries - Snoqualmie chum are harvested to an unknown extent in Canadian fall chum fisheries in the Johnstone and Georgia straits and after mid-September.

Terminal Fisheries - No impacts specific to Snoqualmie chum are available.

STOCK DEFINITION PROFILE for Snoqualmie Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN									■	■	■	■	UNK
RIVER ENTRY									■	■	■	■	UNK
SPAWNING											■	■	UNK

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

GENETICS - GSI sampling was initiated in 1992.

STOCK STATUS PROFILE for Snoqualmie Fall Chum

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	NO DATA			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				

AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Unknown

SCREENING CRITERIA

Hatchery -- Hatchery operational impacts have not been determined. The Skykomish Hatchery on the Wallace River rears chinook, chum, coho and pink salmon. However, there are no hatchery rearing programs for chum in the Snoqualmie watershed.

Last ten years salmon releases into the Snohomish basin.

Release Year	Summer Chinook	Fall Chinook	Chum	Coho	Pink
1982	684567	2131851	1280000	584729	38125
1983	1377898	1069000	800000	700900	0
1984	148500	1581200	1843000	3019697	0
1985	632900	1035000	6598000	1895463	0
1986	616300	2609750	2500000	2069447	168480
1987	398200	1057660	260300	2377065	0
1988	227900	2960500	0	1443052	207000
1989	201000	992500	5800000	1349218	0
1990	1252600	1926870	5800000	1758273	0
1991	212000	2257314	4400000	2259598	0
MEAN	575187	1762165	3253478	1745744	137868

SNOHOMISH -- WALLACE FALL CHUM

STOCK DEFINITION AND ORIGIN

Wallace chum are separated from other chum stocks geographically. Spawning in the Wallace and its tributaries occurs during November and December with the peak coming in late November to early December. Spawning occurs in the Wallace from the mouth upstream at least to Gold Bar (RM 6.0). Spawning also occurs in tributaries to the Wallace including Olney Creek and Ruggs Slough.

Wallace chum are currently considered native but may be hybrids because chum from Grays Harbor (1916 - 1920) and Hood Canal (late 1970s) have been introduced into the Wallace via the Skykomish Hatchery. Genetic analysis has shown that Wallace chum are genetically distinct from other Puget Sound stocks although Wallace and Skykomish chum are similar. Further investigation is needed.

STOCK STATUS

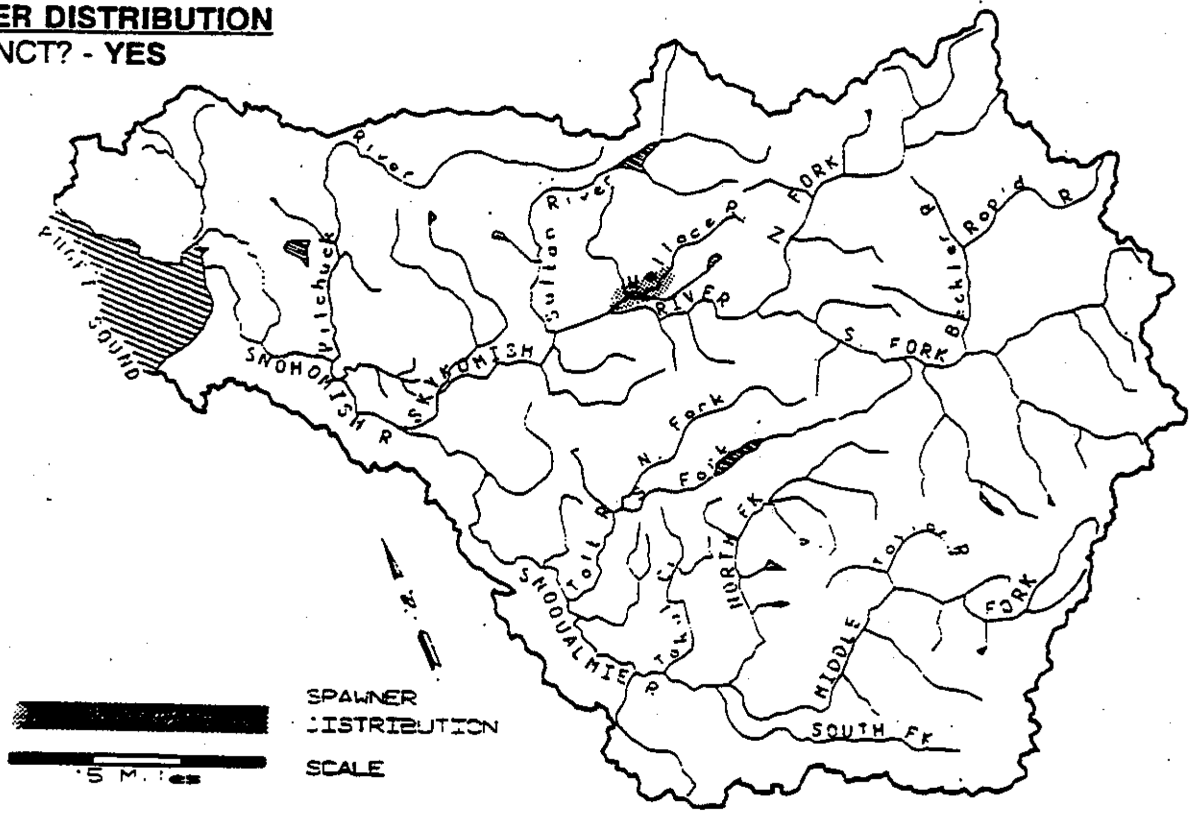
The status of the stock is Healthy based on trends in spawning escapement.

Escapement estimates are not normally generated for components of runs, however essentially all of the Wallace component of the run is surveyed. The numbers should be suitable for showing trends.

Returns of the Wallace component of Snohomish basin chum range from 890 to 12,000 in odd-numbered years and from 6,100 to 38,000 in even-numbered years. Escapements range from 345 to 7,000 for odd years and from 2,900 to 16,000 for even years.

STOCK DEFINITION PROFILE for Wallace Fall Chum

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY													**UNK**
SPAWNING													**UNK**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

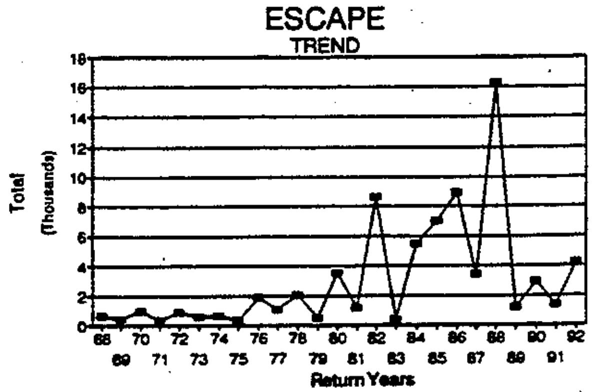
GENETICS - A GSI sample was collected in 1989. More sampling is planned. Genetic analysis has not been completed.

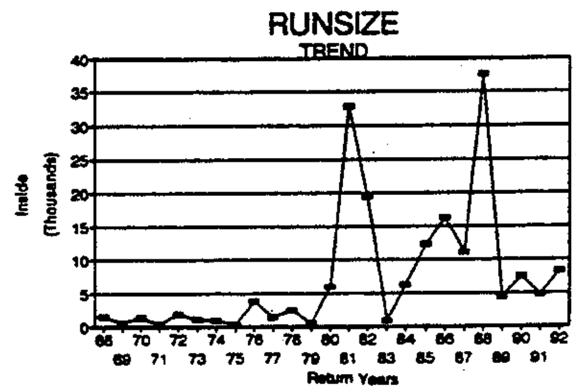
STOCK STATUS PROFILE for Wallace Fall Chum

STOCK ASSESSMENT

DATA QUALITY-----> NOT AVAILABLE

Return Years	ESCAPE Total	RUNSIZE Inside		
68	669	1551		
69	415	566		
70	974	1332		
71	287	366		
72	894	1937		
73	586	1126		
74	669	938		
75	287	365		
76	1867	3847		
77	1047	1347		
78	2053	2541		
79	504	549		
80	3579	5994		
81	1201	32899		
82	8644	19422		
83	345	891		
84	5480	6248		
85	7035	12266		
86	8951	16225		
87	3466	11102		
88	16281	37631		
89	1187	4409		
90	2919	7509		
91	1370	4784		
92	4231	8268		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution

STOCK STATUS

Healthy

SCREENING CRITERIA

OVERVIEW -- SNOHOMISH COHO STOCKS

SNOHOMISH — **SOUTH FORK SKYKOMISH**
SKYKOMISH — **SNOQUALMIE**

STOCK DEFINITION AND ORIGIN

Coho salmon utilize almost all of the accessible tributaries draining into this system. Coho returning to these tributaries typically enter freshwater in September and October and spawn from late October through January, with some variation among streams and among years within streams.

There were substantial releases of hatchery-origin yearlings from the early 1950s to the mid-1960s and irregular releases of yearlings thereafter, until 1980. Currently there are annual yearling releases from the Skykomish Hatchery on the Wallace River and from the Tulalip Tribal Hatchery on Tulalip Bay. There have been off-station fingerling and/or fry releases of various magnitudes in this system since the early 1950s.

All coho stocks in the Snohomish system except the South Fork Skykomish stock (a non-native hatchery stock introduced above Sunset Falls) are probably mixtures of native and non-native fish, although the contribution of hatchery-origin fish to naturally spawning coho stocks in this system is unknown. No estimates of the genetic impacts of non-native fish can be made until genetic stock identification analyses are undertaken.

Because there are no genetic data and no significant timing differences or unique biological characteristics among these stocks, their distinction is based primarily upon geographic spawning separation. This distinction is the result of subjective judgement regarding the probability of significant spawner interchange among drainages. Differences in releases of hatchery fish among streams in the Snohomish system are assumed to have resulted in differences in impacts on native stocks. So differences in release histories have provided secondary support for stock distinctions based on geographic separation.

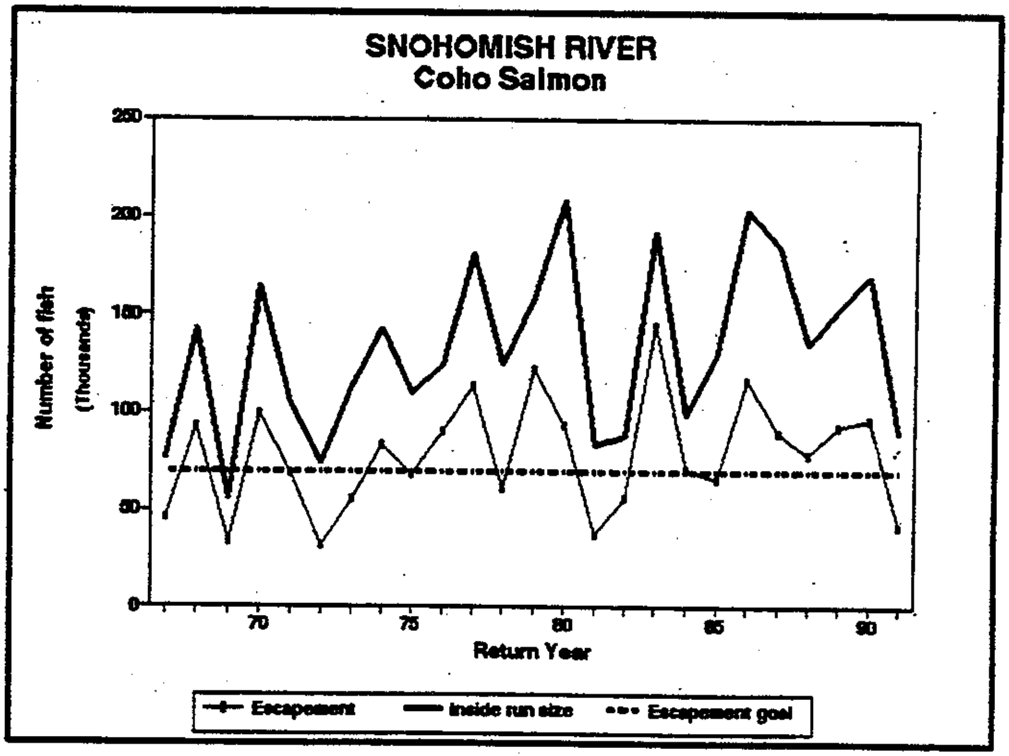
STOCK STATUS

Snohomish River basin origin coho are primarily harvested in Canadian troll, net and sport fisheries and in Washington troll net and sport fisheries. This stock supports terminal area fisheries in Possession Sound, Port Gardner and Port Susan.

The natural escapement goal for the Snohomish River is 70,000. The run reconstruction database shows escapement and run-size estimates (escapement plus Puget Sound net catches) from 1965 to the present fluctuating over a broad range with escapements reaching or exceeding the goal in 14 of those 27 years. These run reconstruction data cannot be broken down to represent the component stocks, so individual stock performance evaluations are based upon stock assessment databases (escapement survey data generally dating back to the late 1970s or early to mid-1980s, depending on the stocks, with the exception of the South Fork Skykomish stock. That stock's performance evaluation is based upon Sunset Fall trap counts of returning adults from 1958 to the present. The Snohomish stock (the mainstem and tributaries below the confluence of the Skykomish and Snoqualmie rivers) has demonstrated a short-term severe decline in escapement, giving cause for concern. The remaining stocks in this basin have been judged to be relatively stable and healthy.

The figure below, which illustrates natural coho production trends in this basin, is derived from the run reconstruction database. The current escapement goal is plotted for all years on this graph, although specific escapement goals for harvest management purposes were not calculated until the late 1970s.

More information on each stock is presented in separate Stock Reports.



SNOHOMISH -- SNOHOMISH COHO

STOCK DEFINITION AND ORIGIN

This stock was designated on the basis of geographic spawning distribution. The primary tributaries to the mainstem Snohomish are at least six river miles below the forks, and it is believed that straying of fish destined for the Snoqualmie and Skykomish systems is not significant. There do not appear to be any unique temporal distribution (spawning is from late October to mid-January and occasionally into February) or documented unique biological characteristics to clearly separate Snohomish coho from upriver stocks.

Significant numbers of hatchery-origin yearlings were released sporadically into the Pilchuck River system and Worthy Creek between 1952 and 1969. Additional yearling plants were made into the Pilchuck River in 1978 and into French Creek in 1979 and 1980. These fish were predominantly Skykomish stocks, however, there were two yearling releases each of Issaquah and Skagit stocks into the Pilchuck River. Skykomish stock hatchery fry and fingerlings have been released into mainstem Snohomish tributaries, usually in limited numbers, since 1958. There were five releases of Issaquah stock fingerlings or fry, one release of University of Washington stock fry and one Green River fingerling release in this area prior to 1964. Some hybridization may have occurred during the period of fingerling releases. The level of mixing would be a function of the number of hatchery-origin fish surviving to spawn relative to the native spawning population, as well as any differential spawning success between the two groups. The contribution of the fry/fingerling releases to the spawning population is probably minimal, given the relatively small numbers released and the corresponding expectation of limited returns from those plants. This stock is likely a mixture of the native and the introduced non-native stocks.

STOCK STATUS

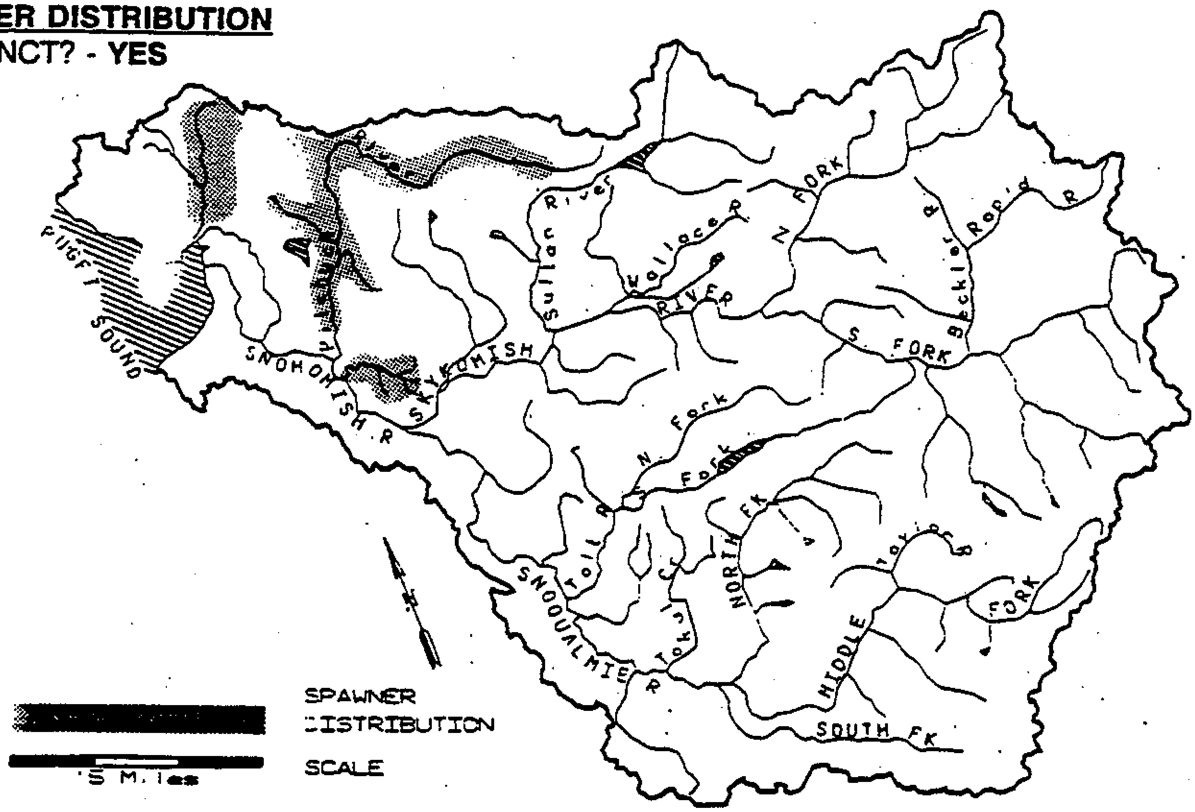
The status of the stock is Depressed based on trends in spawning escapement.

Run reconstruction do not distinguish this stock from other Snohomish River system stocks. There are three escapement indices that represent Snohomish tributaries outside the Pilchuck system, but consistent data for those streams extends back only to 1983. We survey seven Pilchuck tributaries, but the database is short there as well, extending back only to 1984. The quality of these escapement data are very good.

The database does not permit any long-term trend analysis, but the data for this stock indicate a short-term severe decline. The 1990 and 1991 escapement index counts are consistently the lowest in the database (approximating half the mean).

STOCK DEFINITION PROFILE for Snohomish Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													UNK
SPAWNING													UNK
													NO

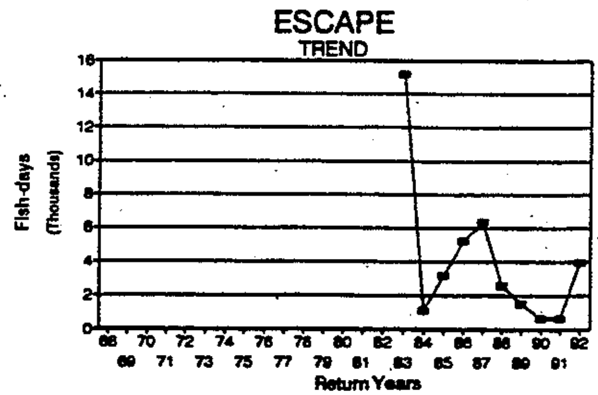
BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

STOCK STATUS PROFILE for Snohomish Coho

STOCK ASSESSMENT

DATA QUALITY-----> Good

Return Years	ESCAPE Fish-days			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83	15174			
84	1142			
85	3221			
86	5228			
87	6327			
88	2616			
89	1512			
90	636			
91	637			
92	3976			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Mixed

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Depressed

SCREENING CRITERIA
Short Term Severe Decline

FACTORS AFFECTING PRODUCTION

Habitat - Historical and continuing habitat problems exist in the mainstem Snohomish River due to agricultural diking and industrial pollution. The river also lacks large woody debris following extensive land clearing and lacks a new source of trees to provide large woody debris in the future as a result of logging and conversion of forests to agricultural and suburban uses. The stock is probably also limited by loss of estuarine wetlands and degradation of nearshore habitat in Port Gardner (Beauchamp, Pflug and Lucchetti 1987).

Harvest Management - The best source of data for harvest impacts on coho salmon is from coded-wire tag recoveries. Unfortunately, there has been no coded-wire tagging of coho from this stock. Naturally-produced fish from elsewhere in the Snohomish system have been tagged at Sunset Falls. In addition, there is regular annual tagging of coho releases at Skykomish Hatchery (within the Snohomish system) and of Skykomish stock from the nearby Tulalip Hatchery, and there were several years of tagging of wild coho in the Stillaguamish River.

The average estimated overall harvest rate for tagged coho from Sunset Falls (broodyears 1976 through 1984, Bill Tweit, WDF, personal communication, 1993) was approximately 70 percent. In contrast, the estimated average overall exploitation rate for tagged Stillaguamish wild coho for broodyears 1984 through 1986 was approximately 87 percent (this report, harvest management section for the Stillaguamish coho stock). The overall average harvest rate for the Snohomish coho stock is likely somewhere between these two numbers. It will be impossible to pinpoint it more precisely until there are recoveries of tags from a group which is definitely representative of this stock.

Analysis of the tag recovery data from the Sunset Falls group shows that the fraction of the landed catch harvested in Canadian fisheries (primarily West Coast of Vancouver Island troll and Strait of Juan de Fuca net) varied from 40 to 70 percent, the fraction landed in Stillaguamish/Snohomish terminal area net fisheries varied from 15 to 30 percent, and the fraction landed in Puget Sound sport and preterminal net fisheries varied from 10 to 25 percent. The fraction landed in ocean sport and troll fisheries off the coasts of Washington and Oregon ranged from 15 to 20 percent, except in years when ocean fisheries were heavily restricted and the fraction landed was generally less than 10 percent. The lower number likely applies under current ocean management.

Harvest management plans for Puget Sound coho in Washington fisheries are designed to meet escapement needs for primary natural stock management units, one of which is the wild coho in the Snohomish River system, of which the Snohomish coho stock is one component.

Hatchery - Hatchery operational impacts have not been determined. There are hatchery rearing and/or release programs for summer chinook, fall chinook, coho and pink salmon at the WDF Skykomish Hatchery on the Wallace River. The Tulalip Tribal Hatchery rears and/or releases fall chinook and chum. Impacts of hatchery fish releases on the wild stock have not been examined.

Last ten years salmon releases into the Snohomish basin.

Release Year	Summer Chinook	Fall Chinook	Chum	Coho	Pink
1982	684567	2131851	1280000	584729	38125
1983	1377898	1069000	800000	700900	0
1984	148500	1581200	1843000	3019697	0
1985	632900	1035000	6598000	1895463	0
1986	616300	2609750	2500000	2069447	168480
1987	398200	1057660	260300	2377065	0
1988	227900	2960500	0	1443052	207000
1989	201000	992500	5800000	1349218	0
1990	1252600	1926870	5800000	1758273	0
1991	212000	2257314	4400000	2259598	0
MEAN	575187	1762165	3253478	1745744	137868

SNOHOMISH -- SKYKOMISH COHO

STOCK DEFINITION AND ORIGIN

This stock was designated on the basis of geographic spawning distribution. These fish have no documented distinct biological characteristics and have no distinct temporal distribution (spawning is from November through mid-January, occasionally to mid-February and rarely into March).

Local stock on-station yearling releases have been made into the Wallace River/May Creek system since at least 1952 with only one significant non-local stock release (Issaquah, 1954). There were also significant off-station releases of Skykomish stock yearlings into Skykomish River tributaries between 1952 and 1966 and in 1979. Introduction of non-local stock yearlings has been limited to two 1973 Issaquah stock releases (into Carpenter Creek and the NF Skykomish), and one release of a hybrid between Sunset Falls and Cowlitz coho was made in 1976 into the Sultan River. Off-station tributary releases of Skykomish fry and fingerlings have occurred in varying degrees from 1952 to the present. Introductions of non-local stock fry and fingerlings were all made prior to 1976 and include one release of Green River stock, four releases of Issaquah stock and two Skagit stock plants. Skykomish coho are likely a mixture of the native and introduced non-native stocks.

STOCK STATUS

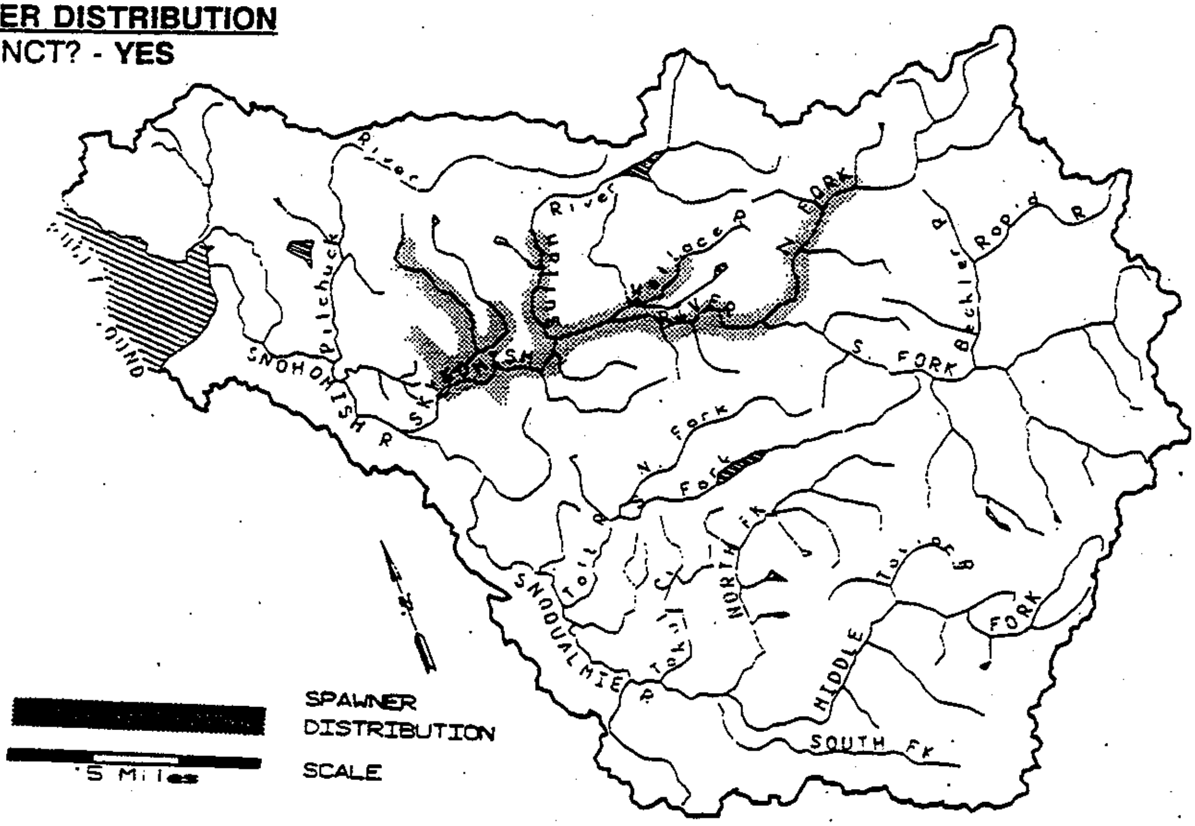
The status of the stock is Healthy based on trends in spawning escapement.

Run reconstruction data do not distinguish this stock from other Snohomish River system stocks. Good escapement data are available from Skykomish index tributaries back to 1981.

The escapement index database demonstrates a rather wide range of annual fish-day totals but no readily discernible long-term negative trend. It should be noted that the 1991 escapement is the lowest in the database and, in spite of the generally stable trend, another return of like magnitude in the near future would indicate a short-term severe decline.

STOCK DEFINITION PROFILE for Skykomish Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													UNK
SPAWNING													UNK
													NO

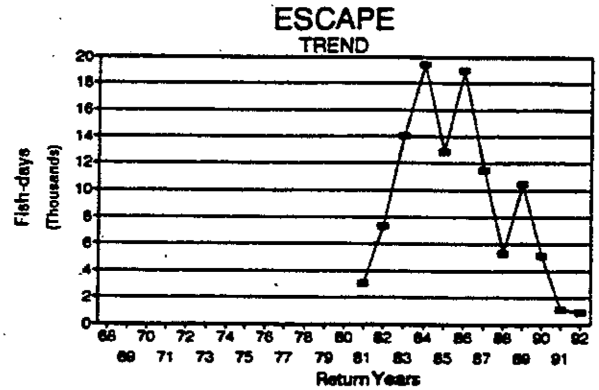
BIOLOGICAL CHARACTERISTICS
DISTINCT? - **UNKNOWN**

STOCK STATUS PROFILE for Skykomish Coho

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Fish-days			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81	3093			
82	7354			
83	14015			
84	19439			
85	12825			
86	18992			
87	11476			
88	5331			
89	10446			
90	5154			
91	1126			
92	883			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Mixed

PRODUCTION TYPE
Composite

STOCK DISTINCTION
Distribution

STOCK STATUS
Healthy

SCREENING CRITERIA

SNOHOMISH -- SOUTH FORK SKYKOMISH COHO

STOCK DEFINITION AND ORIGIN

This stock has been designated on the basis of geographic spawning distribution. Sunset Falls is a block to upstream migration, so seeding is dependent either on juvenile releases or on physical transport of adults above the falls. Straying to the falls is thought to be minimal. These fish do not exhibit any documented distinct biological characteristics, and spawn timing is not available as there have been no systematic surveys in this watershed.

There were no naturally spawning coho in this area prior to hatchery stock introductions. Skykomish stock fry and fingerlings were released into this system in 1952 through 1956 and in 1958. Green River stock fry were released above Sunset Falls in 1952 and 1957 through 1958. This stock has been classified as non-native.

STOCK STATUS

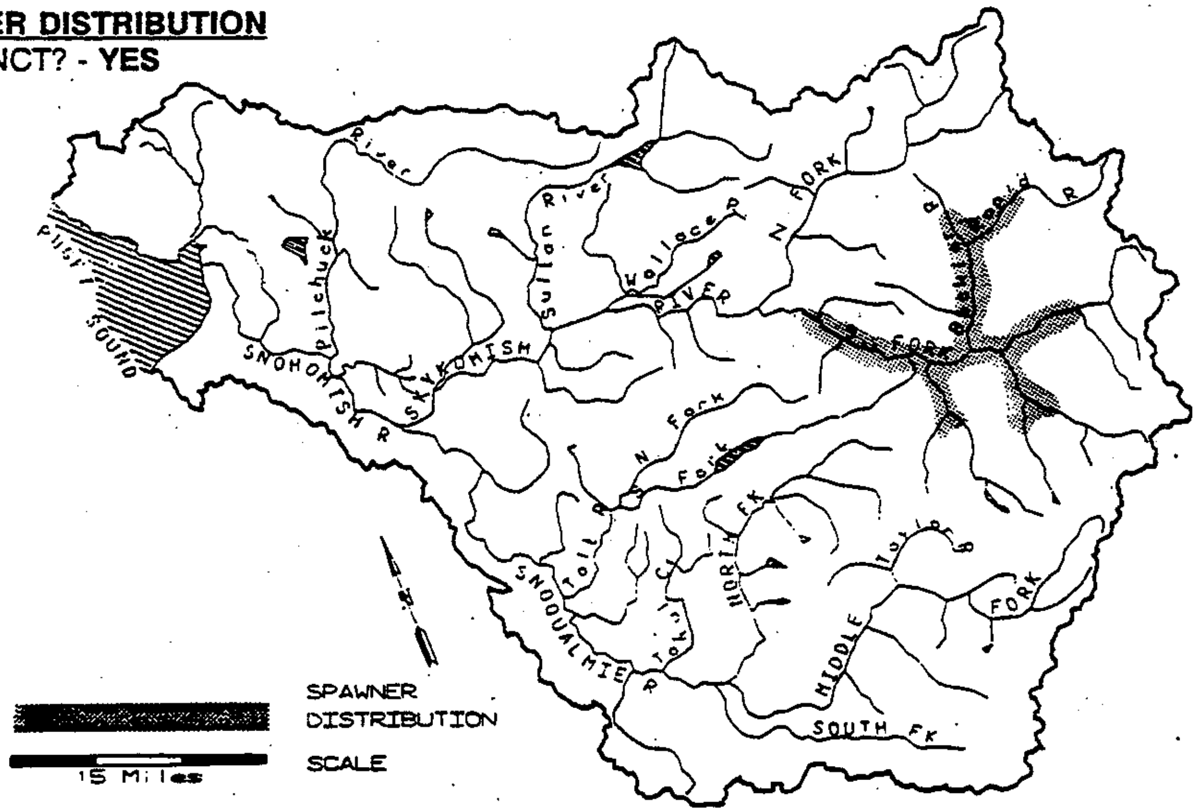
The status of the stock is Healthy based on trends in spawning escapement.

Run reconstruction data do not distinguish this stock from other Snohomish River system stocks. Excellent escapement data are available in the form of passage counts at Sunset Falls (1958-1991). These counts indicate that spawning escapement is quite stable for this stock.

STOCK DEFINITION PROFILE for South Fork Skykomish Coho

SPAWNER DISTRIBUTION

DISTINCT? - **YES**



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													**UNK**
RIVER ENTRY													**UNK**
SPAWNING													**UNK**

BIOLOGICAL CHARACTERISTICS

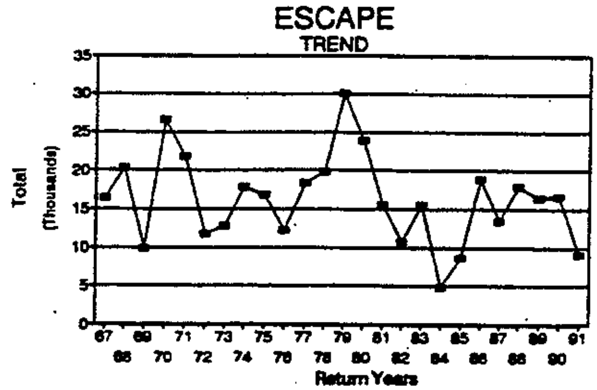
DISTINCT? - **UNKNOWN**

STOCK STATUS PROFILE for South Fork Skykomish Coho

STOCK ASSESSMENT

DATA QUALITY——> Very Good

Return Years	ESCAPE Total			
67	16429			
68	20444			
69	9946			
70	26643			
71	21759			
72	11790			
73	12797			
74	17903			
75	16803			
76	12251			
77	18336			
78	19787			
79	30041			
80	23960			
81	15506			
82	10685			
83	15515			
84	4825			
85	8705			
86	18929			
87	13472			
88	17926			
89	16393			
90	16654			
91	9115			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Non-native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Healthy

SCREENING CRITERIA

SNOHOMISH -- SNOQUALMIE COHO

STOCK DEFINITION AND ORIGIN

This stock has been designated on the basis of geographic spawning distribution. No unique biological characteristics have been documented for this stock, and its spawning timing is not distinct (early November through late January).

There have been substantial off-station releases of various hatchery stocks in this drainage. Issaquah stock yearlings were planted here in 1952 through 1956, 1958, 1959, 1962 through 1966 and 1970 through 1972. Green River yearling releases occurred in 1955, 1958, 1960, 1965 and 1971, while Skykomish stock was released in 1959 through 1962 and 1964 through 1966. Samish stock yearlings were released here in 1957. Green River, Skykomish, Skagit, Samish and Issaquah stocks have all been released into this system as fry or fingerlings. This stock is likely a mixture of the native and the introduced non-native stocks.

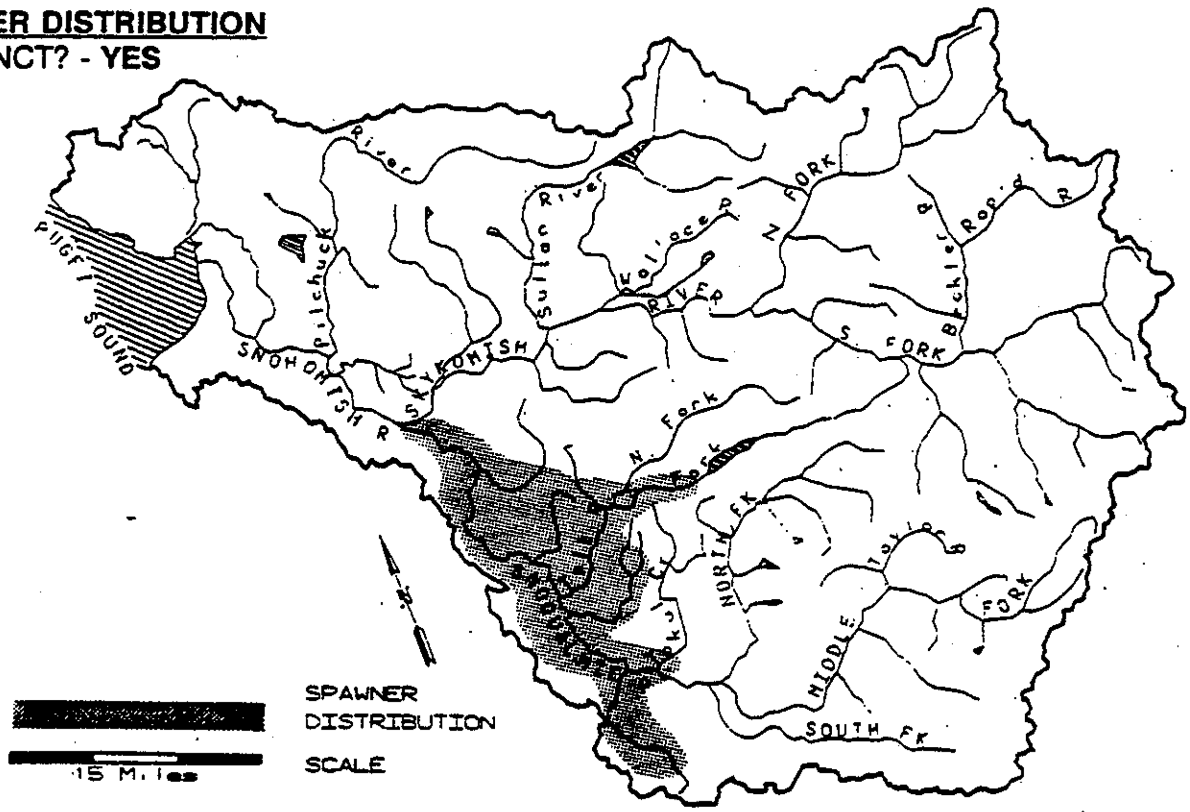
STOCK STATUS

The status of the stock is Healthy based on trends in spawning escapement.

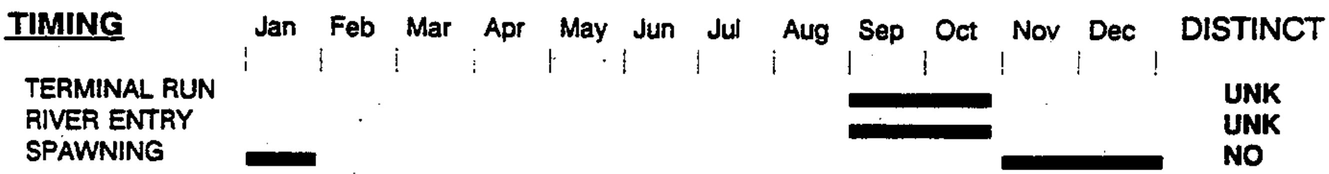
Run reconstruction data do not distinguish this stock from other Snohomish River system coho stocks. Escapement data for Snoqualmie index tributaries are the most comprehensive in Puget Sound. There has been widespread coverage, and there are reliable counts dating back to 1977. Snoqualmie index counts indicate that spawning escapement is stable for this stock.

STOCK DEFINITION PROFILE for Snoqualmie Coho

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

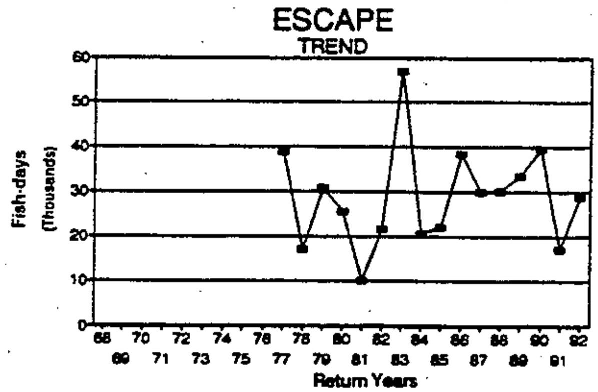
070369
GRIZZLY CK

STOCK STATUS PROFILE for Snoqualmie Coho

STOCK ASSESSMENT

DATA QUALITY----> Very Good

Return Years	ESCAPE Fish-days			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77	38814			
78	17132			
79	30838			
80	25476			
81	10183			
82	21553			
83	56920			
84	20577			
85	22078			
86	38425			
87	30033			
88	30130			
89	33444			
90	39489			
91	17185			
92	28802			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Mixed

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution

STOCK STATUS
Healthy

SCREENING CRITERIA

OVERVIEW -- SNOHOMISH PINK STOCKS

SNOHOMISH ODD-YEAR
SNOHOMISH EVEN-YEAR

STOCK DEFINITION AND ORIGIN

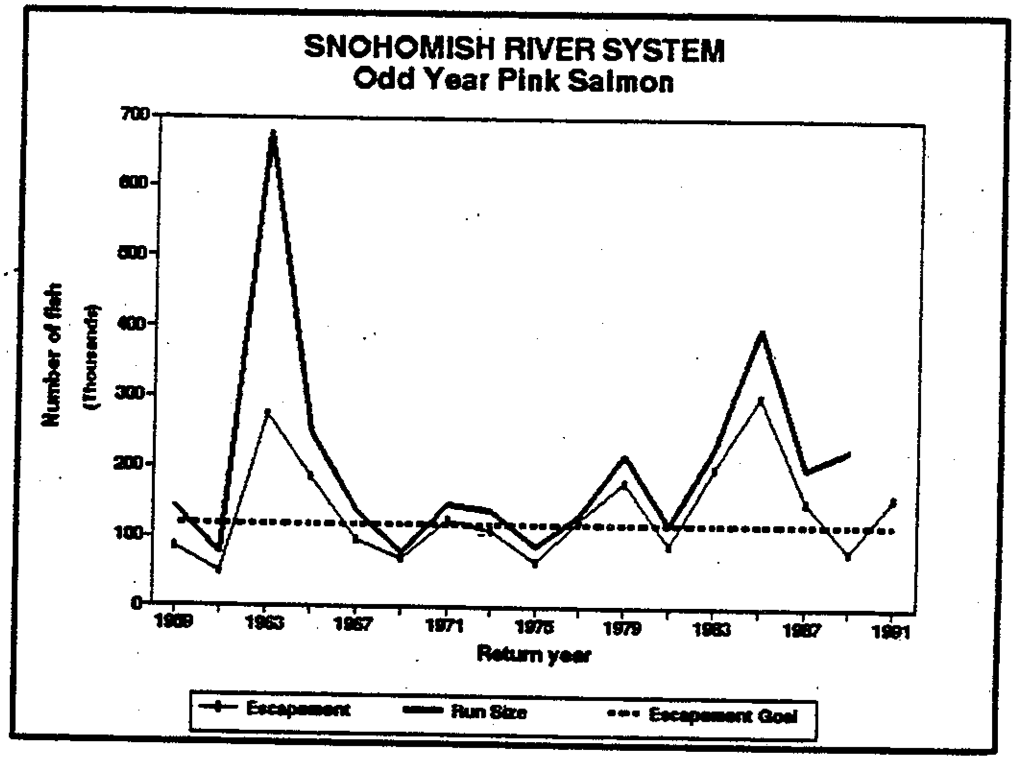
Snohomish pink salmon are separated from all other pink salmon stocks geographically. Within this system two stocks are defined: odd-year spawners and even-year spawners. The odd-year stock spawns from mid-September through October of odd-numbered years and is found throughout the drainage in all accessible mainstem waters and in larger tributaries. The even-year stock spawns primarily in September in even-numbered years in the mainstem Snohomish and in lower reaches of the Skykomish.

Genetic evidence indicates that the odd-year stock is distinct from but closely related to other northern Puget Sound pink stocks. The even-year stock is very different from all known Puget Sound pink stocks. The odd-year stock is presumed to be native whereas the even-year stock may be native, the result of historical introduction or a hybrid of native and introduced fish.

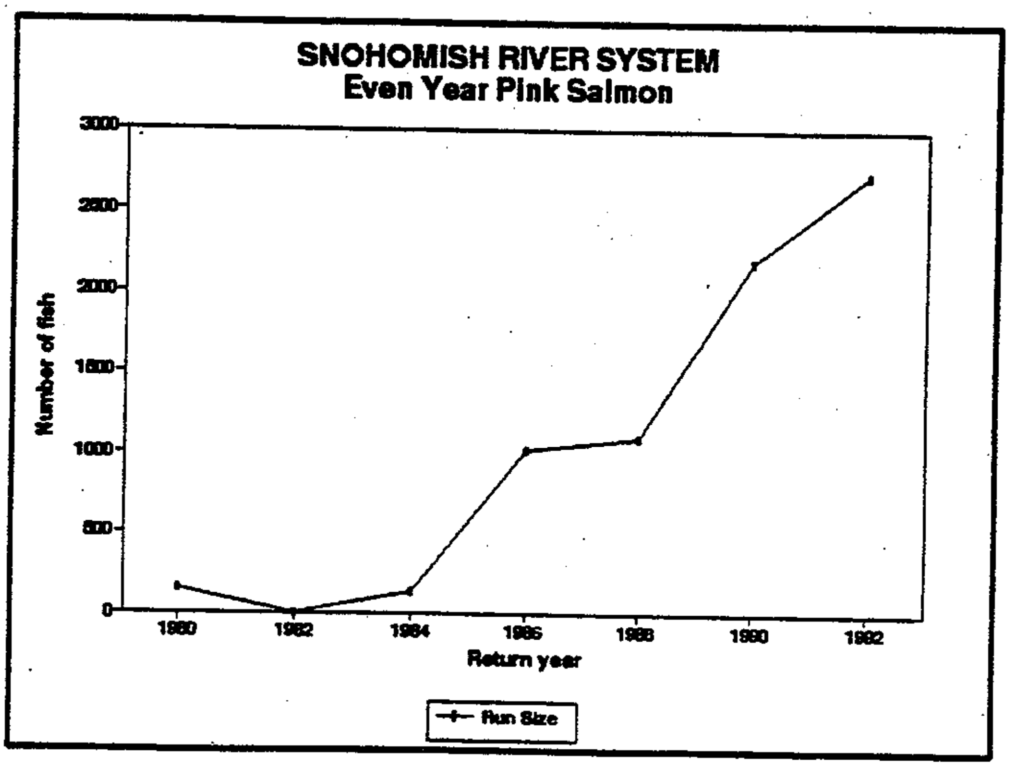
STOCK STATUS

The odd-year stock is by far the most numerous with recent total returns ranging from 200,000 to over 500,000. The escapement goal is 120,000 (see first figure). Snohomish odd-year pinks are taken in various mixed-stock commercial fisheries and are targeted in commercial and tribal net fisheries in Port Gardner/Port Susan (Area 8A). They are also taken in both saltwater and freshwater sport fisheries. The even-year stock is much smaller with escapements in the hundreds to low thousands, although escapements have been increasing (see second figure). They are taken incidentally in marine sport and commercial fisheries but are currently protected in freshwater.

More information on each stock is presented in separate Stock Reports.



SNOHOMISH RIVER SYSTEM
Odd Year Pink Salmon
Number of fish
(Thousands)
700
600
500
400
300
200
100
0
1959
1963
1967
1971
1975
1979
1983
1987
1991
Return year
Escapement
Run Size
Escapement Goal



SNOHOMISH RIVER SYSTEM
Even Year Pink Salmon
Number of fish
3000
2500
2000
1500
1000
500
0
1980
1982
1984
1986
1988
1990
1992
Return year
Run Size

SNOHOMISH -- SNOHOMISH ODD-YEAR PINK

STOCK DEFINITION AND ORIGIN

Snohomish River pink salmon spawn in mainstem waters and in larger tributaries of the Snohomish River and its two principal tributaries, the Snoqualmie and the Skykomish rivers, during odd-numbered years. They are considered distinct from other Puget Sound odd-year stocks because of genetic differences and geographical separation and from Snohomish even-year pinks by timing and genetic differences. Spawning takes place in the mainstem Snohomish from approximately the town of Snohomish (RM 13.0) upstream to the confluence of the Snoqualmie and Skykomish rivers (RM 21.0) with the heaviest spawning above RM 18.0. Spawning occurs in the mainstem Skykomish from the mouth to the confluence of the North and South Forks (RM 50.0). Pinks also ascend the North Fork for approximately 12 miles and the South Fork to the Sunset Falls trap (RM 52.0), where they are collected for transport above the falls. In the Snoqualmie, pinks may ascend as far as Snoqualmie Falls, but spawning occurs primarily near Carnation (RM 20.0 to RM 25.0). Major tributaries in the Snohomish system used for spawning include the Pilchuck, Sultan, Wallace, Beckler and Tolt rivers and in Woods, Elwell, McCoy, Olney, Proctor, Deer, Lewis, Bridal Veil and Cherry creeks.

Odd-year pink salmon enter the Snohomish from mid-August to early October with the peak in mid-September. Spawning may begin in mid-September, peaks during the first two weeks of October and is usually completed by late October. The heaviest spawning activity occurs in the upper two miles of the Snohomish, the lower six miles of the Skykomish, above Sunset Falls on the South Fork of the Skykomish, near Carnation on the Snoqualmie and in the lower reaches of the Sultan and Wallace rivers.

Various components of the Snohomish odd-year pink stock have been analyzed genetically, and no significant differences within the drainage have been identified.

Snohomish odd-year pinks are assumed to be of native origin with only negligible hatchery influence. The only known introductions are of non-native, even-year pinks.

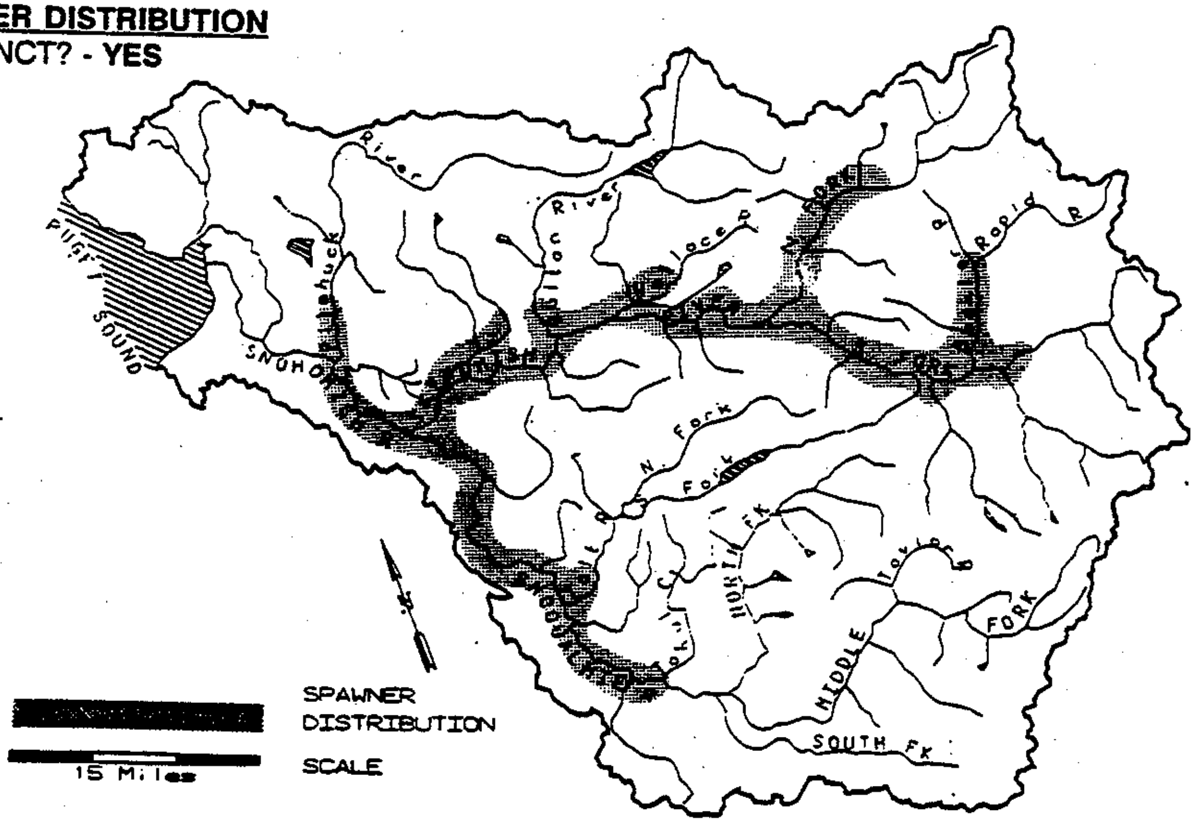
STOCK STATUS

Stock status is Healthy.

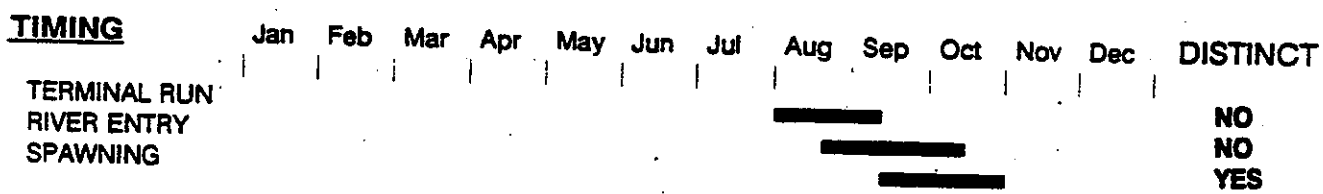
The estimated number of returning Snohomish pink salmon during odd-numbered years has ranged from 123,000 to 531,000 over the last ten cycles, with escapement estimates ranging from 66,000 to 300,000. Estimated total returns are calculated from escapement estimates and harvest data and include Canadian interceptions, which may be sizeable. Escapement estimates are based on a comparison of spawning ground counts in designated index areas to counts for the

STOCK DEFINITION PROFILE for Snohomish Odd-Year Pink

SPAWNER DISTRIBUTION
DISTINCT? - **YES**

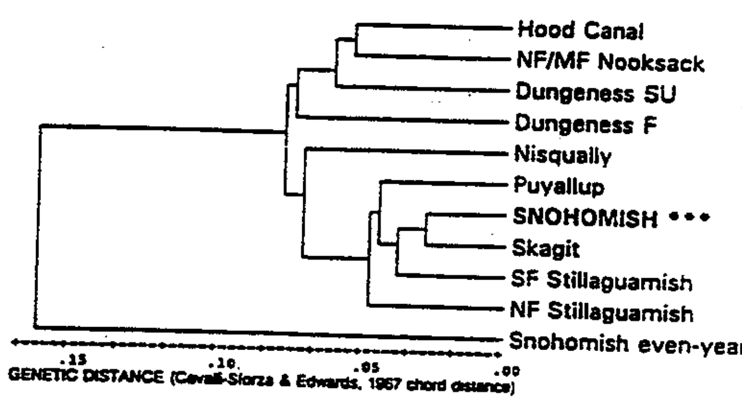


TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - This stock is significantly different from all other Washington stocks [collections from mainstem and from Snoqualmie and Wallace rivers (N=566) 28-locus G-tests: p<0.001)].



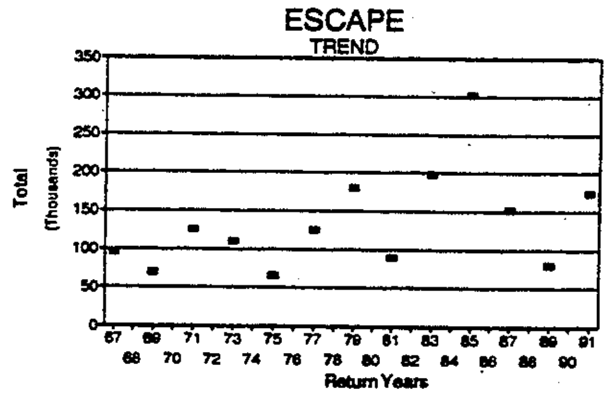
STOCK STATUS PROFILE for Snohomish Odd-Year Pink

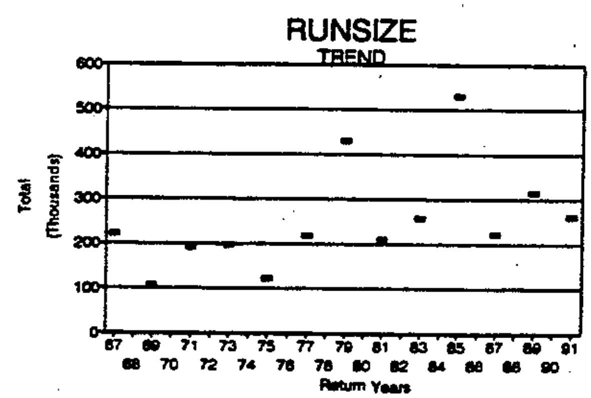
STOCK ASSESSMENT

DATA QUALITY------> NOT AVAILABLE

Return Years	ESCAPE Total	RUNSIZE Total	RUNSIZE Inside	
67	95000	221284	139896	
68				
69	70000	107586	78484	
70				
71	125000	191010	146371	
72				
73	110000	197110	138391	
74				
75	65600	122990	87999	
76				
77	125000	218516	131940	
78				
79	180000	429550	219672	
80				
81	90000	210273	119267	
82				
83	198000	256307	227857	
84				
85	302000	530640	400633	
86				
87	152000	223302	199632	
88				
89	80133	316570	226664	
90				
91	174000	261288	206940	

Odd-year returns only.





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Distribution, Genetics, Timing

STOCK STATUS

Healthy

SCREENING CRITERIA

same index areas made during 1959, 1961 and 1963, when escapements were determined from tagging studies. The accuracy of these estimates is limited because of habitat changes and spawner redistribution since the tagging studies were conducted. However, they are useful for showing trends because of consistency in survey methods and personnel.

SNOHOMISH -- SNOHOMISH EVEN-YEAR PINK

STOCK DEFINITION AND ORIGIN

The Snohomish even-year pink salmon stock is separated from the Snohomish odd-year stock on the basis of timing and genetic separation and from all other pink stocks by geographical separation in addition to timing and genetic differences. Pink salmon in Washington occur only in two-year cycles, so genetic exchange between the two Snohomish stocks is highly unlikely. This is the only known sustaining run of even-year pinks in the state although even-year pinks are occasionally encountered in other waters of the state.

Even-year pink salmon spawn in the mainstem Snohomish River from the town of Snohomish (RM 13.0) upstream to the confluence of the Snoqualmie and Skykomish rivers (RM 21.0) with the heaviest spawning between RM 18.0 and RM 20.0. Lesser numbers are known to ascend the Skykomish at least as far as Monroe (RM 25.0). Their presence in the Snoqualmie has not been verified. Spawning begins in early September and ends in mid-October with the peak in late September. This is earlier than the odd-year pinks that spawn in the same location.

The origin of this stock is unknown. Even-year pink spawning has been documented in the Snohomish since 1980, but information prior to that year is sketchy. This may represent a native run that has been present in small numbers for many years or one that has been recently established by straying from an even-year population or from populations outside the state. There have also been attempts to introduce even-year pinks from Alaska and British Columbia into Puget Sound waters. More than six million even-year Alaska pinks were planted into the Skykomish River during the 1920s. Other plants have been made into the Skagit, Samish, Puyallup and the Stillaguamish (as recently as 1952). These introductions were thought to be unsuccessful, but the Snohomish stock could be descended from any of these introductions or, perhaps, is a hybrid of native and introduced pinks.

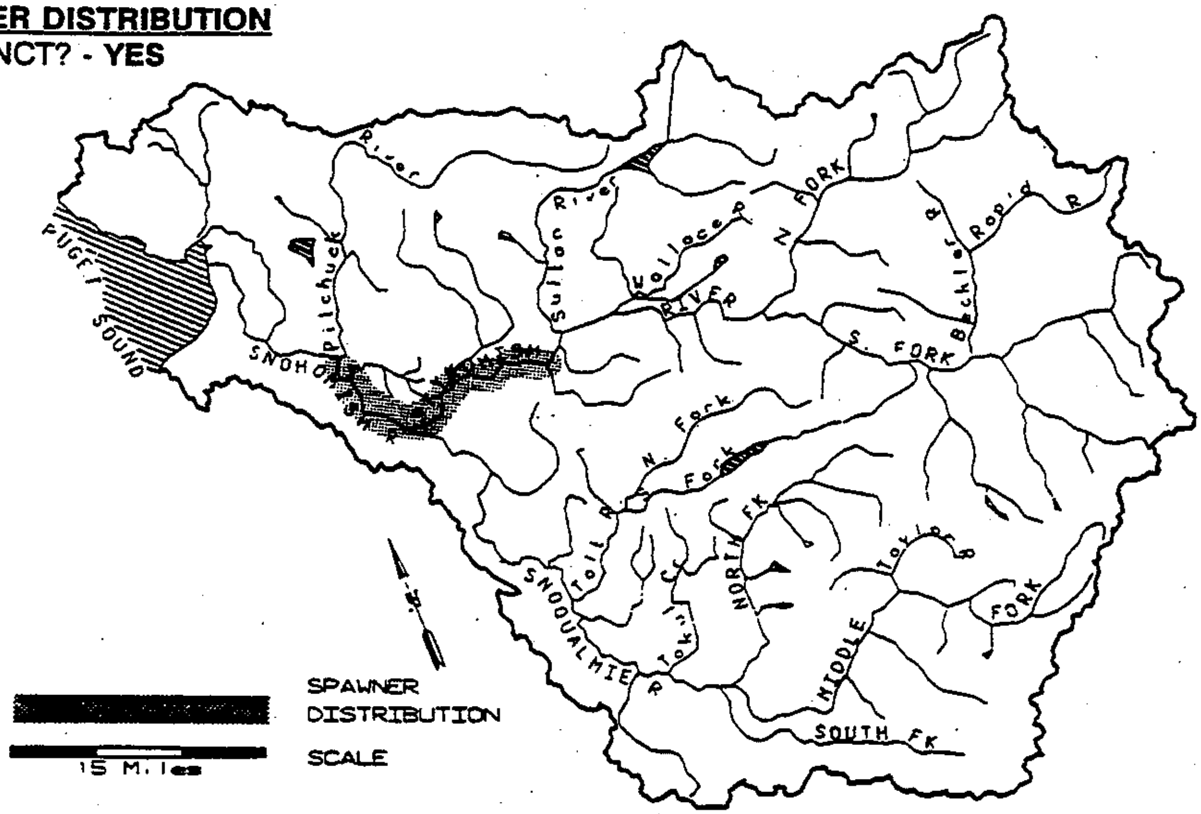
STOCK STATUS

The status of the stock is Healthy based on trends in spawning escapement.

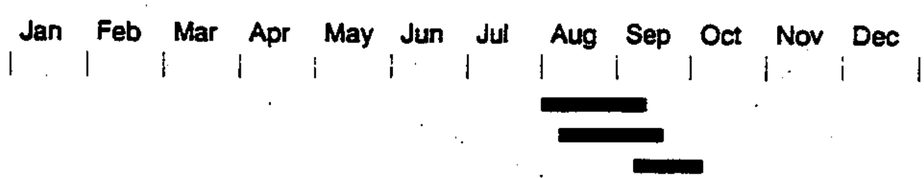
The even-year stock is considerably smaller in numbers than the odd-year stock with escapements ranging from 137 to 2,187. The number of spawners has been increasing in recent years. This stock is at risk because of the small numbers and the fact that its preferred spawning area is subject to frequent flooding. Escapement estimates are based on aerial redd counts made in conjunction with chinook surveys and are considered to be conservative.

STOCK DEFINITION PROFILE for Snohomish Even-Year Pink

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



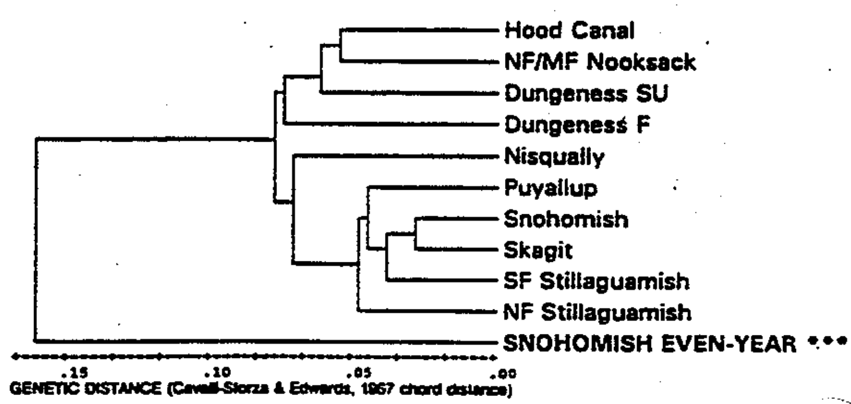
TIMING



TIMING	DISTINCT
TERMINAL RUN	**NO**
RIVER ENTRY	**NO**
SPAWNING	**YES**

BIOLOGICAL CHARACTERISTICS
DISTINCT? - **YES**

GENETICS - This stock is significantly different from all other Washington stocks [one collection from Snohomish mainstem (N=75); 28-locus G-tests: **p**<0.001].



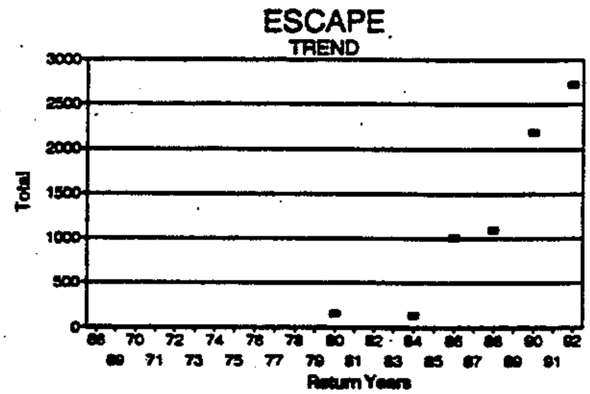
STOCK STATUS PROFILE for Snohomish Even-Year Pink

STOCK ASSESSMENT

DATA QUALITY——> NOT AVAILABLE

Return Years	ESCAPE Total			
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80	151			
81				
82				
83				
84	137			
85				
86	1016			
87				
88	1097			
89				
90	2187			
91				
92	2723			

Even-year returns only.



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Distribution, Genetics, Timing

STOCK STATUS
Healthy

SCREENING CRITERIA

FACTORS AFFECTING PRODUCTION

Habitat -- The generally sediment-free spawning gravels, where they exist in the mainstem Snoqualmie River, are affected by extensive logging which alters stream flows and contributes to sediments in the spawning riffles. Diking occurs from RM 34.0 downstream to its confluence with the Snohomish River. Diking has led to loss of rearing habitat and scouring of spawning habitat. The Sultan River is affected by diking in the lower mile as well as by flow diversions for the City of Everett from a Diversion at Spada Lake (RM 16.5) and another diversion at RM 9.7. The Pilchuck River has historically been impacted by instream gravel mining operations in the lower river. The Snohomish and Machias areas are becoming increasingly developed and urbanized which degrades water quality due to run-off. A City of Snohomish diversion at RM 26.4 on the Pilchuck River may affect upstream migration in the lower river because it reduces flow in the river. The Woods Creek watershed near Monroe is experiencing urban growth, and stream flows may also be affected by extensive logging in the area near Lake Roesiger. Agricultural and residential activities also degrade water quality (Thornburgh et al. 1991) Elwell Creek possesses good-quality habitat in its lower two miles. All the mainstem and tributary reaches in urban and agricultural areas lack large conifer trees. As a result, large woody debris, which creates instream habitat, is generally deficient. The mainstem Snohomish River and Port Gardner Bay are affected by agricultural diking and industrial pollution.

Harvest Management -- Snohomish River even-year pinks may be harvested in Canadian and United States preterminal Fraser Panel fisheries and in terminal commercial and sport fisheries in Port Gardner/Port Susan. In Fraser Panel fisheries, this stock may be taken in fisheries operating at harvest rates appropriate for Fraser River late-timed sockeye stocks. U.S. terminal net fisheries targeting fall chinook and coho may also impact even-year pinks, although the harvest rate is likely lower than those applied to the targeted stocks.

The total Fraser Panel fishery catch of U.S.-origin even-year pinks is unavailable because the catch contribution of Canadian-origin stocks is unknown. Terminal area harvests have not been estimated in run reconstruction for this stock. No stock identification methods are yet employed or available to distinguish Snohomish even-year pinks from other stocks within Fraser Panel and terminal fisheries.

<u>Preterminal Fisheries</u> - Snohomish even-year pinks may be harvested in Canadian Vancouver Island fisheries targeting on Fraser River sockeye. These fisheries sometimes extend into late August and September.

Preterminal harvest areas in U.S. waters under Fraser Panel control that may impact this stock include the Strait of Juan de Fuca (Areas 4B, 5 and 6C) and the San Juan Islands areas (Areas 6, 7 and 7A). An unknown number of Snohomish even-year pinks may also have been harvested in Strait of Juan de Fuca, San Juan Island and Admiralty Inlet (Area 9) recreational fisheries.

Terminal Fisheries - No directed fisheries on Snohomish even-year pinks have occurred. The major terminal area commercial net fisheries directed at other salmon species that may incidentally impact even-year pinks occur in Port Gardner/Port Susan (Area 8A) and the Tulalip Bay vicinity (Area 8D). Port Gardner and Snohomish River sport fisheries may also intercept these fish. In 1992, sport catch restrictions for the Snohomish River to protect this stock were promulgated requiring release of pink salmon in even-numbered years.

The 1982-1990 commercial net harvest of pink salmon in even-numbered years averaged 25 in Port Gardner/Port Susan, 21 in the Tulalip Bay vicinity and 0 in the Snohomish River (WDF/Tribal Historical Commercial Catch and Effort database). The 1982-1990 sport harvest of pink salmon in even-numbered years was negligible (WDF Sport Catch Reports).

Hatchery -- Effects of the Skykomish Hatchery facility located on the Wallace River are unknown. The hatchery rears and releases summer and fall chinook and coho. The Tulalip Tribal Hatchery rears and releases coho and chum. The impacts of these releases on wild fish are not known.

Last ten years salmon releases into the Snohomish basin.

Release Year	Summer Chinook	Fall Chinook	Chum	Coho	Pink
1982	684567	2131851	1280000	584729	38125
1983	1377898	1069000	800000	700900	0
1984	148500	1581200	1843000	3019697	0
1985	632900	1035000	6598000	1895463	0
1986	616300	2609750	2500000	2069447	168480
1987	398200	1057660	260300	2377065	0
1988	227900	2960500	0	1443052	207000
1989	201000	992500	5800000	1349218	0
1990	1252600	1926870	5800000	1758273	0
1991	212000	2257314	4400000	2259598	0
MEAN	575187	1762165	3253478	1745744	137868

OVERVIEW -- SNOHOMISH SUMMER AND WINTER STEELHEAD STOCKS

SUMMER:	**WINTER:**
TOLT	**SNOHOMISH / SKYKOMISH**
NORTH FORK SKYKOMISH	**PILCHUCK**
SOUTH FORK SKYKOMISH	**SNOQUALMIE**

STOCK DEFINITION AND ORIGIN

In the Snohomish River system, three summer steelhead stocks and three winter steelhead stocks have been identified. Wild summer steelhead in the forks of the Tolt River, the upper North Fork Skykomish River, the upper South Fork Skykomish River and wild winter steelhead in the Snohomish/Skykomish, Snoqualmie, and Pilchuck rivers are distinct stocks. The summer steelhead in the Tolt and North Fork Skykomish are native and the South Fork Skykomish summer steelhead stock was developed by colonization of non-native fish. Wild winter steelhead in each stock are native.

There is little or no information available to indicate that these are genetically distinct stocks. The stocks are treated separately due to the geographical isolation of the spawning populations and, in some cases, biological characteristics. There may be more or fewer stocks identified once comprehensive genetic information is available.

Run-timing of the summer steelhead stocks (May through October) is distinct from run-timing of the winter steelhead stocks (November through April).

The native summer stocks were historically small runs of fish limited by their habitats. These fish developed in areas isolated from the native winter stocks. In the Snohomish River system this occurs upstream of falls that were probable migration barriers except during the low flows of summer and fall. Since only a few miles of stream were used, summer steelhead populations were small.

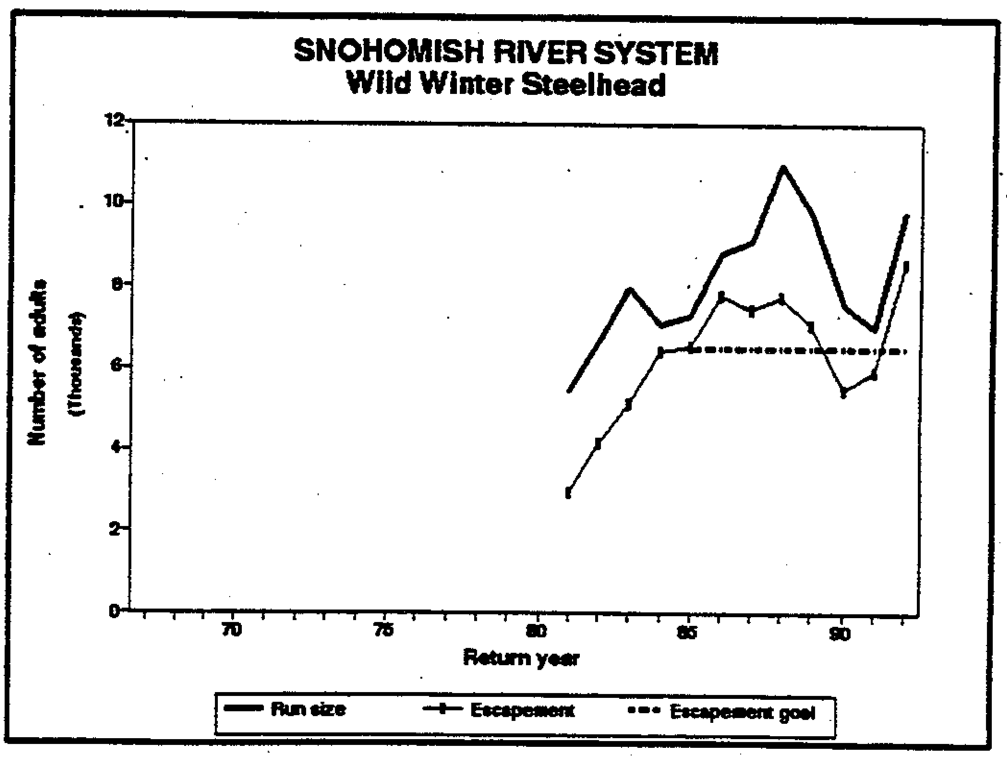
While about 350,000 hatchery winter steelhead smolts are planted in the Snohomish River system annually, there is little contribution to the wild stock from hatchery fish spawning in the wild. The returning hatchery adults support tribal and sport fisheries with a combined exploitation rate of about 90%. In addition, a proportion of returning hatchery adults are collected at the WDFW Skykomish Hatchery and serve as brood stock for a major portion of the Puget Sound winter steelhead hatchery program. Given the high exploitation of the hatchery fish, healthy wild spawner escapements, and the difference in spawn-timing between the hatchery fish (January and February) and the wild fish (mid-February through May), the potential for interbreeding is limited.

About 125,000 to 225,000 hatchery summer steelhead smolts are stocked in the Snohomish River system annually. The potential for interbreeding between the more numerous hatchery fish and the wild fish certainly exists, but the contribution to the wild stock by hatchery fish spawning in the wild is unknown. A proportion of returning hatchery adults serve as brood stock for the summer steelhead hatchery program in Puget Sound. Management strategies are presently being reviewed to reduce potential interbreeding.

STOCK STATUS

Wild winter steelhead spawner escapement and run size have been monitored for the Snohomish River system since the 1980-81 season. Wild escapement has ranged from 2,954 to 8,588 fish and wild run size has ranged from 5,464 to 11,006 fish (see figure).

Beginning with the 1984-85 season, an escapement goal of 6,500 winter steelhead was set for the Snohomish River system and the fisheries were managed to achieve the goal. This goal is to be achieved by wild adults and does not include hatchery fish spawning in the wild. In the eight seasons since the escapement goal was set, wild escapement has averaged 7,019 fish and exceeded the goal six times (see figure).



The wild winter steelhead run in the Snohomish River system is fished upon by the Tulalip Tribes in the mouth of the Snohomish and in nearby marine waters (Area 8A). Sport anglers fish in the mainstems of the Snohomish, Snoqualmie, and Skykomish as well as in major tributaries such as the Pilchuck, Sultan, Wallace, North Fork Skykomish, South Fork Skykomish, Tolt, and Raging rivers and Tokul Creek. The targeted tribal fishery occurs primarily during December and January while the sport fishery occurs from November through March on the mainstems and through February on the tributaries. There is also a catch-and-release sport fishery on the lower Skykomish during March and April that targets the Snohomish/Skykomish stock.

During the 1980-81 through 1991-92 return years, the wild winter steelhead run in the Snohomish River system was comprised of 14.4% sport harvest, 8.5% tribal harvest, and 77.1% escapement (see table).

Snohomish River system wild winter steelhead sport harvest, tribal harvest, spawner escapement, and run-size from 1980-81 through 1991-92.

Return year	Sport harvest	Tribal harvest	Spawner escapement	Run-size
1980-81	1,004	1,506	2,954	5,464
1981-82	1,086	1,397	4,160	6,643
1982-83	1,627	1,202	5,158	7,987
1983-84	423	237	6,432	7,092
1984-85	149	622	6,536	7,307
1985-86	257	765	7,790	8,812
1986-87	1,032	630	7,464	9,126
1987-88	2,286	979	7,744	11,009
1988-89	2,250	493	7,078	9,821
1989-90	1,888	197	5,498	7,583
1990-91	839	225	5,936	7,000
1991-92	1,209	35	8,588	9,832
Mean run-size distribution, 1980-81 to 1991-92				
	1,171	691	6,278	8,140
	14.4%	8.5%	77.1%	

Wild summer steelhead spawning escapement is not monitored and escapement goals have not been identified for the South Fork Skykomish and North Fork Skykomish stocks. Numbers of wild adult summer steelhead are being monitored during snorkel surveys on the Tolt River and an escapement goal has been set based on the available habitat and distribution of winter and summer steelhead in the Tolt River. There are no tribal fisheries that target Snohomish River system summer steelhead, but they may be caught incidentally in other tribal salmon and steelhead fisheries. These stocks have been managed with wild steelhead release regulations to protect the wild stocks from sport harvest in freshwater areas since 1992, but some hook-and-release mortality may occur. It is expected that with current regulations in place these stocks will reach population levels dictated by their limited habitats. Because of the small population sizes and limited habitats used, wild summer steelhead populations will always be fragile.

Wild steelhead release regulations have been in effect in all marine areas since 1993.

More information on each stock is presented in separate Stock Reports.

SNOHOMISH -- TOLT SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in the forks of the Tolt River are a distinct stock based on the geographical isolation of the spawning population.

Wild summer steelhead enter the Snoqualmie and Tolt rivers from May through October, however data are unavailable on time of first (and last) entry. As far as is known, the only habitat historically selected for summer runs is located in the forks of the Tolt River. Wild summer steelhead, which aggregate in the upper Snoqualmie River, may ultimately spawn in the Tolt, or some other river. Although specific run-timing and spawn-timing are unknown, run-timing is generally from May through October and spawn-timing occurs in the spring and may be similar to other steelhead stocks in the Puget Sound area (February through April).

Presence of native, wild summer steelhead in the Tolt is supported by historic accounts and popular publications which preceded any stocking of hatchery-origin summer stocks. However, almost nothing is known or published about their historic abundance, entry and spawn-timing, or size distribution (Pfeifer 1990). While there is little doubt that a native run of steelhead historically returned to the Tolt, uncertainty about the level of contribution by hatchery fish spawning in the wild results in an Unknown stock origin designation.

Currently, wild fish are being enumerated by late summer/fall snorkel counts, and are differentiated from hatchery strays by presence of adipose fins. Mid-winter snorkeling and fish collections may begin in 1993-94. The genetic origin of the wild run component is highly questionable due to the lengthy term of hatchery fish stocking, plus a lack of data on the genetic makeup of the native fish, their historic run-timing, size characteristics, and spawning distribution.

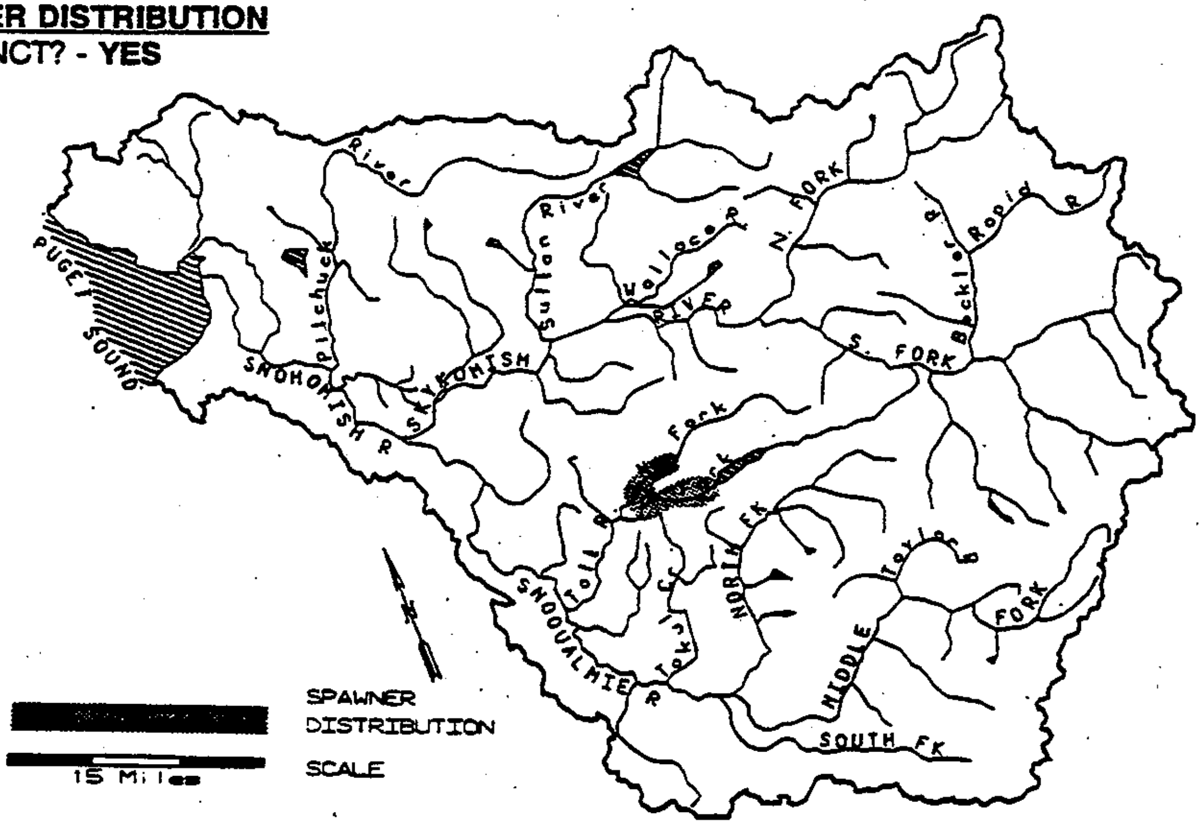
There is little life history information available for wild summer steelhead in the Tolt. A sample of 36 fish taken from anglers' creels in 1981-82 found 11 percent were fish that reared in freshwater one year and two plus years in saltwater (1.2+), 28 percent were fish which reared two years in freshwater and one plus year in saltwater (2.1+), 53 percent were fish that reared two years in freshwater and three plus years in saltwater (2.3+), and three percent were fish that reared three years in freshwater and two plus years in saltwater (3.2+). Wild summer runs in the Kalama River in 1977 were 19 percent age four, 73 percent age five, and eight percent age six. Comparable percentages in the Tolt were 39 percent, 53 percent, and eight percent. Thus, Tolt wild summer runs tend to return more at age four than Kalama summers.

Length at age for Tolt summers in 1981-82 (n=52) was 66 cm for age four; 72 cm for age five, and 82.5 cm for age six. Comparable mean lengths for Kalama River summer runs in 1978 were 59 cm, 72 cm, and 76 cm.

STOCK DEFINITION PROFILE for Tolt Summer Steelhead

SPAWNER DISTRIBUTION

DISTINCT? - YES



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													UNK
SPAWNING													UNK

BIOLOGICAL CHARACTERISTICS

DISTINCT? - UNKNOWN

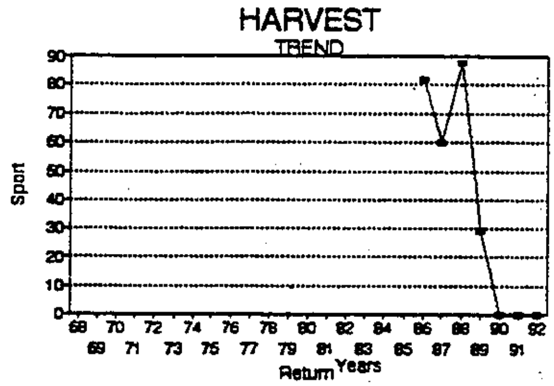
STOCK STATUS PROFILE for Tolt Summer Steelhead

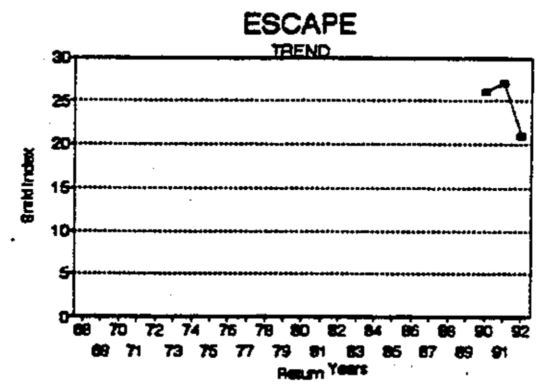
STOCK ASSESSMENT

DATA QUALITY-----> Fair

Return Years	HARVEST Sport	ESCAPE Snrkl Index		
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86	82			
87	60			
88	88			
89	29			
90	0	26		
91	0	27		
92	0	21		

Escapement Goal=121





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

SNOHOMISH AND SNOQUALMIE SPORT CATCHES OF TOLT-ORIGIN FISH ARE NOT AVAILABLE

STOCK SUMMARY

STOCK ORIGIN
Unknown

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Depressed

SCREENING CRITERIA
Chronically Low

The limited Tolt sample suggests that Tolt summer runs return at a slightly lower mean age, but were larger at age four and six than wild Kalama River stock.

The Tolt and Kalama River life history characters differ substantially from those of Deer Creek (Stillaguamish, North Fork) wild stock, which returns almost entirely as one-salt (2.1+, 3.1+) fish, that is, fish which reared in freshwater for two or three years and spent one plus years in saltwater.

STOCK STATUS

The status of the stock is Depressed.

Definitive statements regarding changes in wild Tolt summer stock status are impossible due to the lack of quality historical information. Although good data exist on general spring spawning in the Tolt forks, it has so far not been possible to separate summer steelhead redds from winter steelhead redds. With the exception of a short reach near the center of the North Fork Tolt, winter steelhead occupy the same habitat as summer fish. Changes in the annual South Fork Tolt hydrograph due to the 1962 construction of the South Fork Dam has eliminated any hypothetical winter flow barrier that may have separated summer from winter runs in that fork.

Published historical anecdotal sport harvest information, plus interviews with retired Department of Game fishery biologists, suggests that the Tolt summer steelhead population was on the order of several hundred fish. A theoretical adult production figure of 570 fish was derived from assumptions about winter steelhead migratory barriers prior to 1962, and summer steelhead production given Tolt habitat conditions. An escapement goal of 121 wild summer steelhead has been set based on available habitat and present distribution of winter and summer steelhead in the Tolt River (Pfeifer 1990).

Currently, wild fish are being enumerated by late summer/fall snorkel counts, and are differentiated from hatchery strays by presence of adipose fins. If the Tolt produced "several hundred" to 570 wild, native summer steelhead prior to 1962, then sport harvests of 30 - 80 wild fish, or fall counts of 20 - 30 fish, even though both are undoubtedly only an index of the total run, probably indicate the stock is chronically Depressed.

Wild summer steelhead have been protected from sport harvest with wild steelhead release regulations since 1992, but some hook-and-release mortality may occur.

FACTORS AFFECTING PRODUCTION

Habitat -- The Tolt basin's glacial history resulted in numerous outcrops of unstable, highly erosive outwash and clay deposits. Severe landslides have heavily impacted, and even temporarily blocked, the river or its forks. Past sedimentation events have probably impacted several year classes significantly (Pfeifer 1990), although the stock(s) should have been able to rebound if fishing pressure had not been constant, or increasing. Detailed studies have recently been completed, or are underway, to better define the role of habitat in Tolt salmon and steelhead production.

Harvest Management -- While incoming Tolt summer steelhead are not likely subjected to significant interception rates in marine fisheries, they are subject to incidental harvest in the Snohomish and lower Snoqualmie rivers. These captures, plus past open fisheries throughout the Tolt and its forks, probably overfished this stock.

We do not have the ability to break out Tolt fish from summer steelhead caught in the Snohomish or Snoqualmie rivers. Recently, wild steelhead release regulations during the summer season were enacted in these (and other) waters which should protect the remnant stock from legal harvest. The anadromous fish habitat in the forks of the Tolt was closed to fishing in 1991 to restore those areas as a spawning and rearing sanctuary. The Tolt mainstem remains open in the summer, but all wild origin steelhead must be released.

Hatchery -- Skamania and Skykomish River origin summer smolts were stocked into the Tolt system between 1963 and 1989. The number stocked ranged from 5,200 to 50,578, and averaged 16,000 in the last decade. There was a significant, positive correlation between the number of smolts stocked and summer harvests between 1963 and 1984 (Pfeifer 1990). What is not known is the degree of escapement of these hatchery stocks, and the degree of past interbreeding with the native stock.

Hatchery summer smolts have not been stocked into the Tolt in recent years due to unavailability (low numbers), as well as concern about incomplete harvests in the Tolt due to restricted access, and the resultant potential for genetic exchange with the remnant wild stock.

SNOHOMISH -- NORTH FORK SKYKOMISH SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild summer steelhead in the North Fork Skykomish River and tributaries are a distinct stock based on the geographical isolation upstream of Bear Creek Falls. Except during low flows, the falls is a barrier to anadromous fish due to high water velocities. This stock is primarily a native stock with some small level of interaction with hatchery summer steelhead.

Run-timing is generally from early July through October. Specific spawn-timing is unknown but is believed to be similar to other wild summer steelhead stocks in the Puget Sound area (February through April).

STOCK STATUS

The status of the stock is Unknown.

This stock had been depressed, but fall adult counts are increasing following recent wild steelhead release regulations. The number of adults seen from the bank during fall surveys in the upper section has increased from 20 to 30 fish in the late 1980s to 60 in 1992 for the same section. During electrofishing surveys in spring 1993, wild summer steelhead fry and parr were abundant.

FACTORS AFFECTING PRODUCTION

Habitat -- The habitat in the upper North Fork Skykomish is generally of good quality, though the stream channel is unstable during flooding.

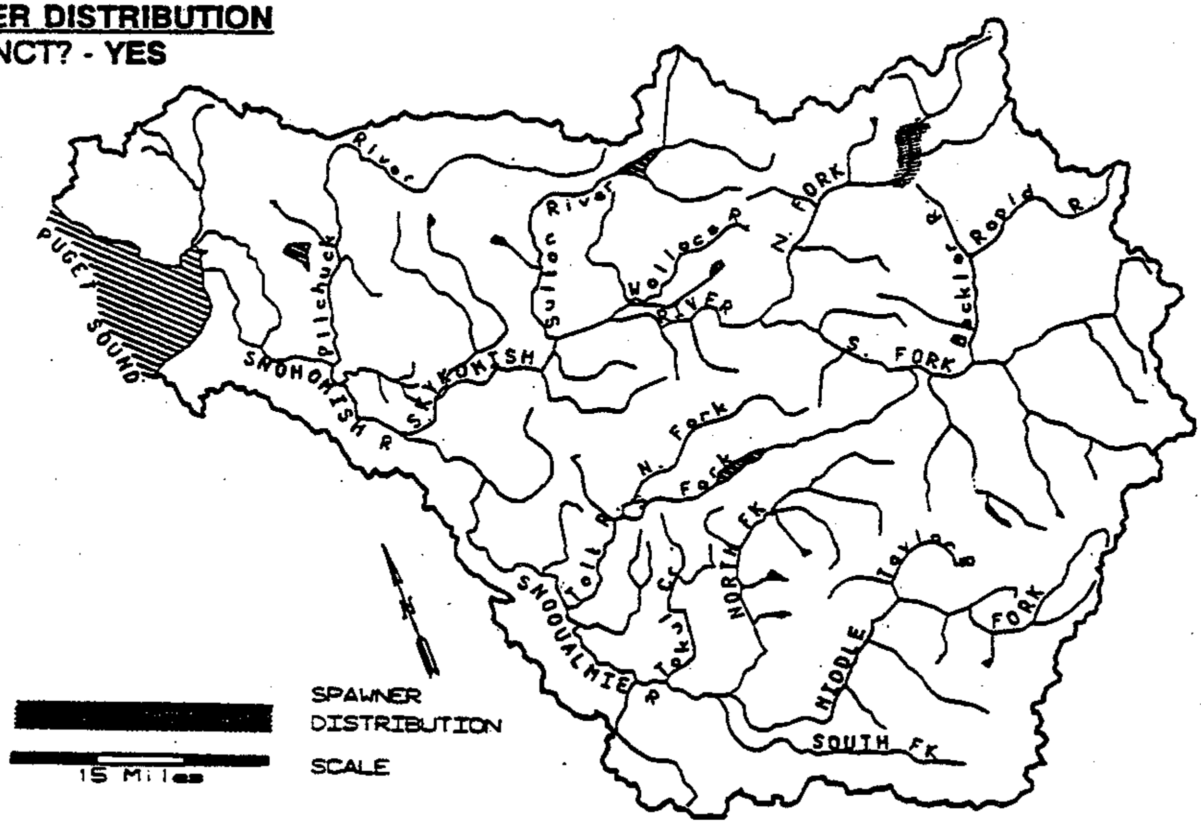
Harvest Management -- Wild steelhead release regulations during the summer since 1990 and the winter closure (sanctuary) above Bear Creek Falls protects this stock from legal sport harvest. There could be incidental harvest by poaching in the river and in commercial salmon fisheries as the fish migrate through marine waters near the river mouth.

Hatchery -- Hatchery summer steelhead do migrate into the upper basin and may interact with the wild fish. Sampling of adults through the late summer and fall indicates that the numbers of hatchery fish decline rapidly after the first fall rains. Presumably, these fish are migrating downstream to the hatchery. It is unknown whether those hatchery fish that remain interact with the wild fish at spawning or whether they also migrate downstream in the spring prior to spawning.

STOCK DEFINITION PROFILE for NF Skykomish Summer Steelhead

SPAWNER DISTRIBUTION

DISTINCT? - YES



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													NO
SPAWNING													UNK

BIOLOGICAL CHARACTERISTICS

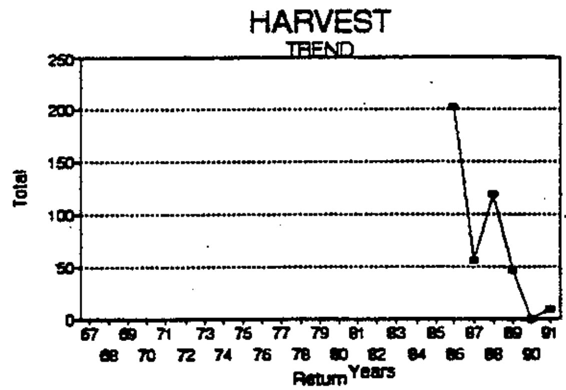
DISTINCT? - UNKNOWN

STOCK STATUS PROFILE for NF Skykomish Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY-----> Fair

Return Years	HARVEST Total			
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86	202			
87	56			
88	119			
89	46			
90	0			
91	10			



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN

Native

PRODUCTION TYPE

Wild

STOCK DISTINCTION

Spawning Distribution

STOCK STATUS

Unknown

SCREENING CRITERIA

SNOHOMISH -- SOUTH FORK SKYKOMISH SUMMER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild (naturally produced) summer steelhead in the South Fork Skykomish River, Beckler River and tributaries upstream of Sunset Falls are non-native and a distinct stock based on the geographical isolation of the spawning population. After the beginning of a trap and haul operation at Sunset Falls by the Washington Department of Fisheries in the mid-1950s, summer steelhead have been able to colonize the habitat upstream of the falls. Fish were from hatchery plants of fry and smolts as well as stray hatchery and wild adults. The primary donor stock was the Skamania Hatchery summer run.

Run-timing is generally from early April through mid-December and spawn-timing is unknown but believed to be from February through April.

STOCK STATUS

The status of the stock is Healthy.

In the last decade, the average number of adults trucked over the falls has averaged more than 1,000 fish. In the early 1980s, spot checks revealed that only about one-third of the returning adults were wild, while spot checks during the 1990s revealed that over half are wild.

FACTORS AFFECTING PRODUCTION

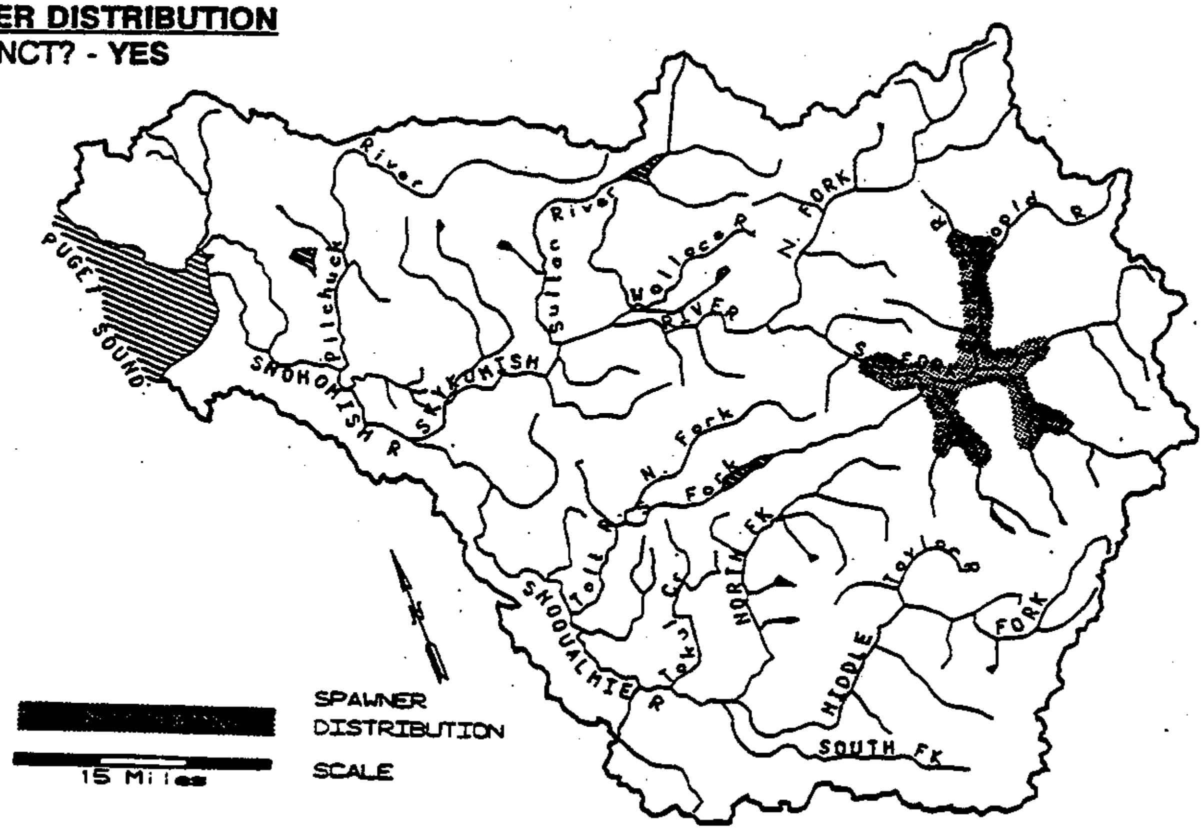
Habitat -- The habitat in the South Fork basin is generally in good shape.

Harvest Management -- Throughout the Snohomish River basin, the stock is protected from harvest by wild steelhead release regulations all summer. The upper South Fork is closed to steelhead fishing during the winter. The population could experience incidental harvest by poaching by sport anglers and in commercial salmon fisheries as the fish migrate through the marine waters near the river mouth.

Hatchery -- Non-native (hatchery) steelhead were the source for this stock.

STOCK DEFINITION PROFILE for SF Skykomish Summer Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY				━	━	━	━	━	━	━	━	━	NO
SPAWNING													UNK

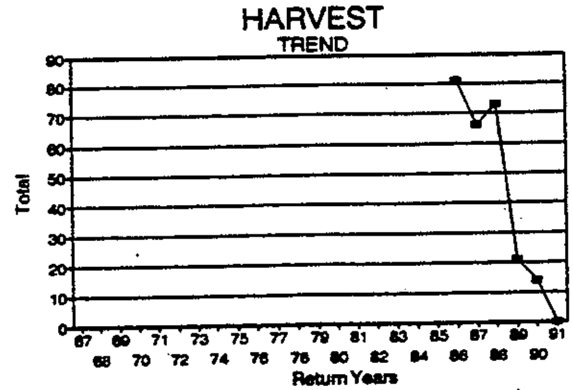
BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

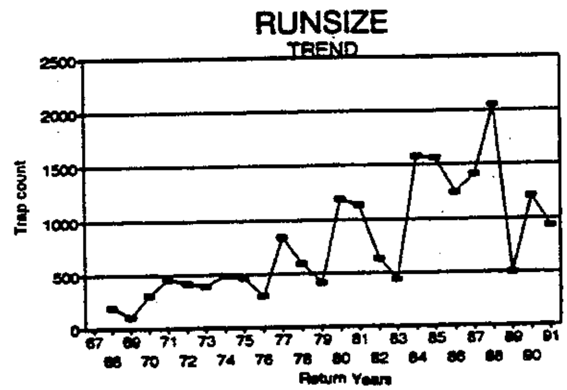
STOCK STATUS PROFILE for SF Skykomish Summer Steelhead

STOCK ASSESSMENT

DATA QUALITY-----> Good

Return Years	HARVEST Total	RUNSIZE Trap count		
67				
68		192		
69		106		
70		303		
71		459		
72		420		
73		395		
74		485		
75		465		
76		292		
77		843		
78		598		
79		412		
80		1196		
81		1137		
82		636		
83		442		
84		1579		
85		1565		
86	81	1245		
87	66	1414		
88	73	2048		
89	21	502		
90	14	1208		
91	0	936		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Non-Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Healthy

SCREENING CRITERIA

SNOHOMISH -- SNOHOMISH / SKYKOMISH WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the mainstems of the Snohomish, Skykomish, Sultan, and Wallace rivers and tributaries are native and a distinct stock based on the geographical isolation of the spawning population. Similar to other wild winter steelhead stocks in the Snohomish River system, run-timing is generally from November through April and spawn-timing is generally from early March to early to mid-June.

STOCK STATUS

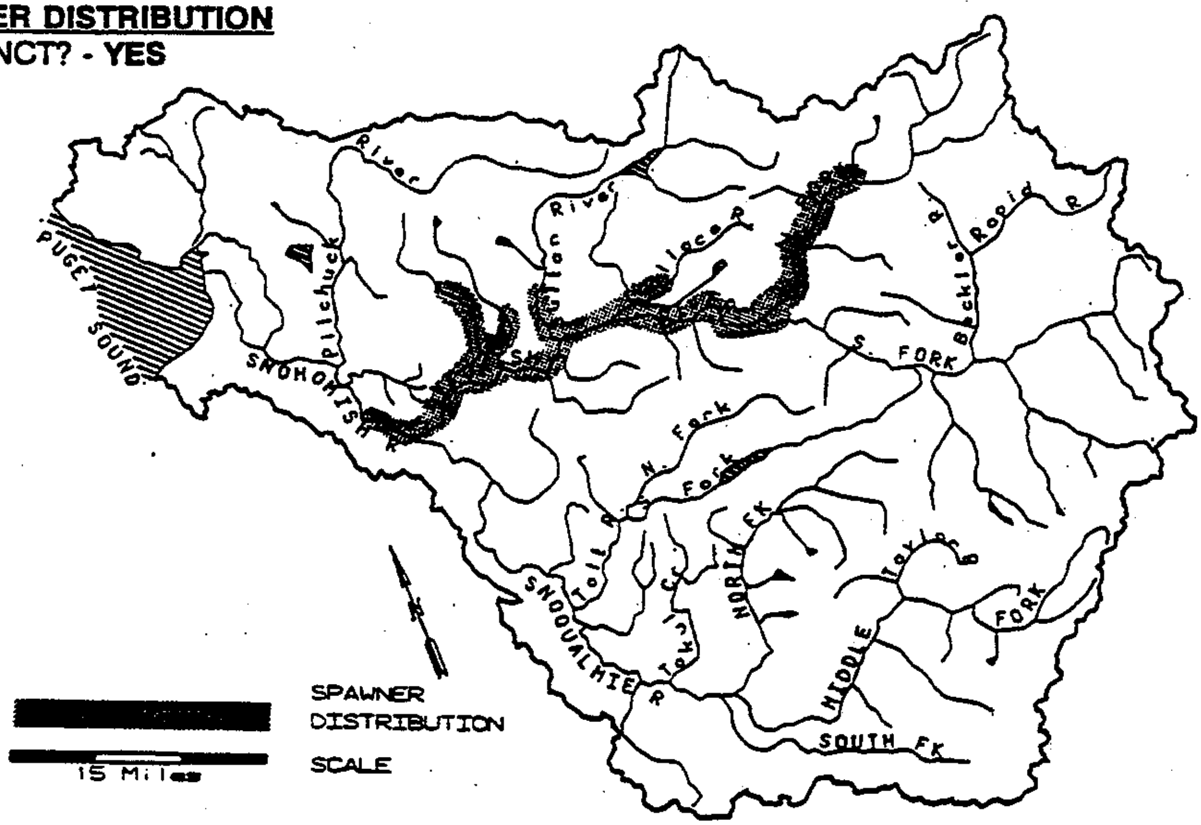
The status of the stock is Healthy.

Since 1982, escapements have been stable and abundant. The Snohomish/ Skykomish stock is part of the Snohomish wild run of steelhead which has consistently met or exceeded the maximum sustained harvest escapement goal (see steelhead Overview report for Snohomish River system).

STOCK DEFINITION PROFILE for Snohomish/Skykomish Winter Steelhead

SPAWNER DISTRIBUTION

DISTINCT? - **YES**



TIMING	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	DISTINCT
TERMINAL RUN													
RIVER ENTRY													NO
SPAWNING													NO

BIOLOGICAL CHARACTERISTICS

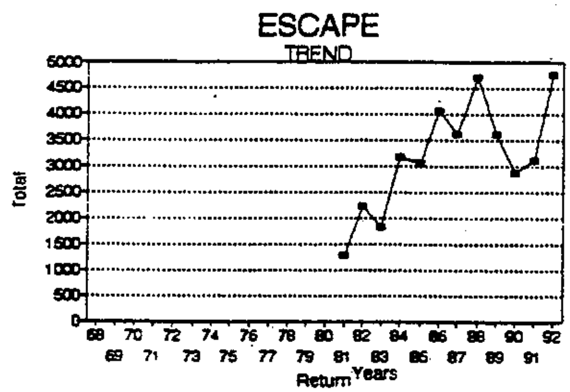
DISTINCT? - UNKNOWN

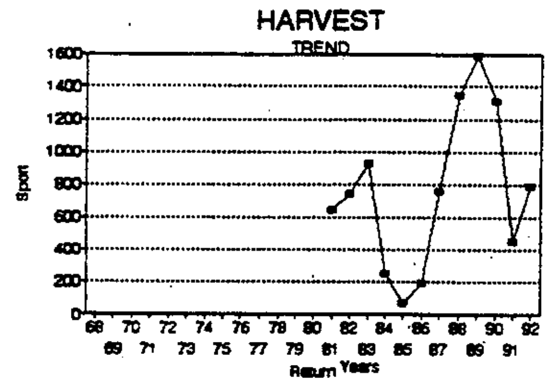
STOCK STATUS PROFILE for Snohomish/Skykomish Winter Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total	HARVEST Sport		
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81	1297	643		
82	2242	749		
83	1843	930		
84	3197	253		
85	3082	69		
86	4076	197		
87	3628	763		
88	4710	1352		
89	3618	1586		
90	2896	1315		
91	3136	451		
92	4760	790		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

SPORT AND TRIBAL HARVEST OCCURS IN MIXED STOCK AREAS BUT CANNOT BE SEPARATED FOR EACH STOCK

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Healthy

SCREENING CRITERIA

SNOHOMISH -- PILCHUCK WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the Pilchuck River and tributaries are a distinct stock based on the geographical isolation of the spawning population and its slightly older age structure than other steelhead in the Snohomish River system. The Pilchuck River enters the Snohomish River 3.5 miles downstream of the lower limit of spawning by the Snohomish/Skykomish stock. As with other wild winter steelhead stocks in the Snohomish River system, run-timing is generally from November through April and spawn-timing is generally from early March to early to mid-June. The percentage of three-salt adults (fish which spend three years in saltwater) returning to the Pilchuck appears to be higher than elsewhere in the basin.

This stock is of native origin and has little interaction with hatchery stocks. The run and spawning timing of this stock, as well as its age structure, remain distinct from that of the hatchery stock.

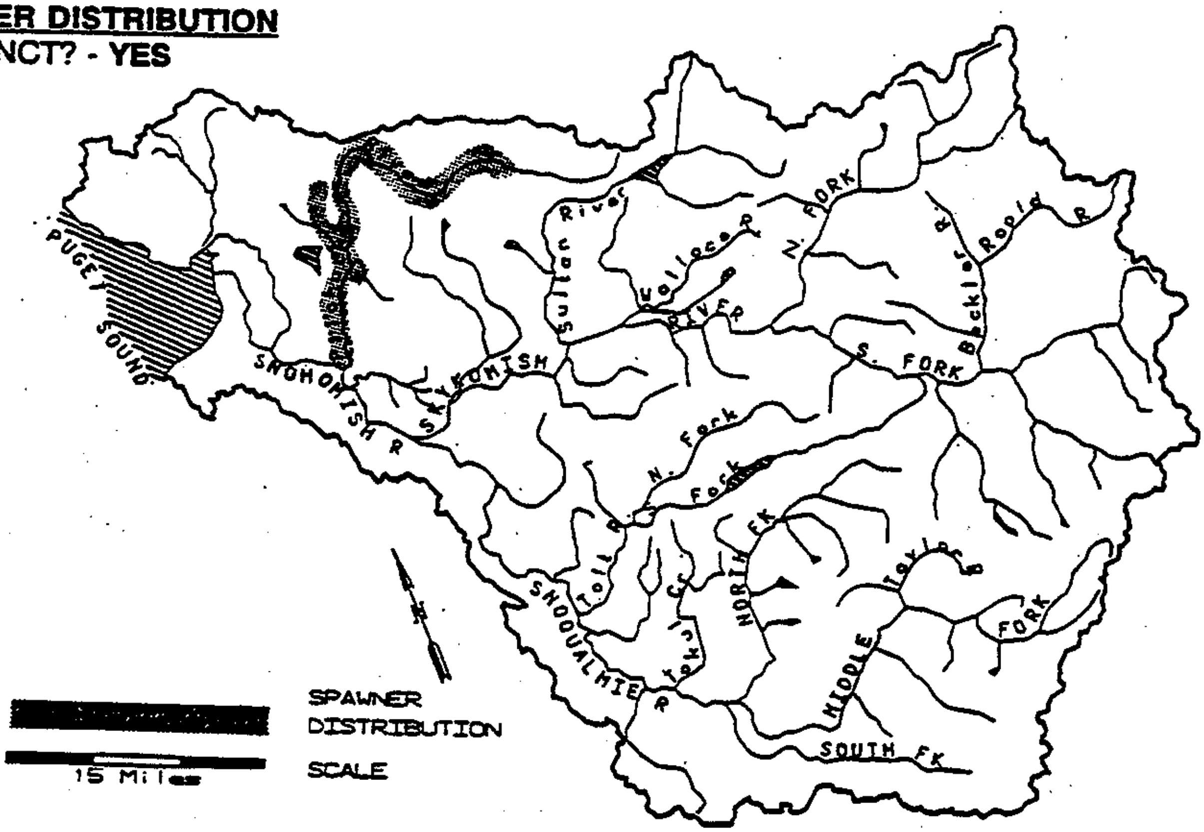
STOCK STATUS

The status of the stock is Healthy.

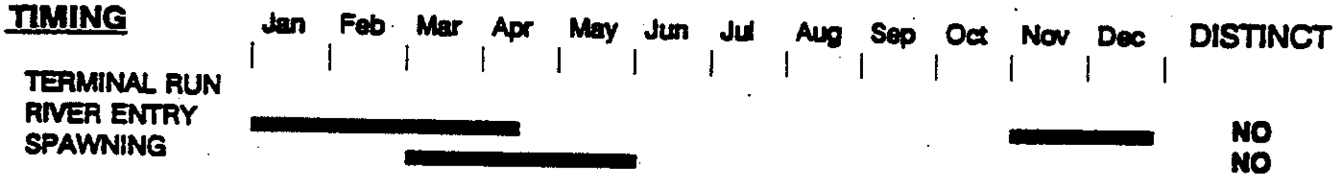
Since 1982, escapements have increased and remained stable. The Pilchuck winter stock is part of the Snohomish wild run of winter steelhead. The Snohomish wild escapement has generally met or exceeded the maximum sustained harvest escapement goal (see steelhead Overview report for Snohomish River system).

STOCK DEFINITION PROFILE for Pilchuck Winter Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - **YES**



TIMING



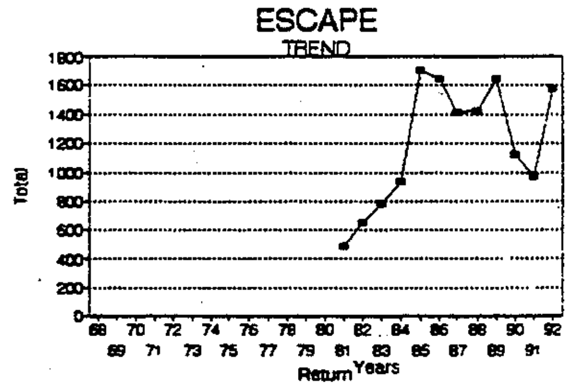
BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

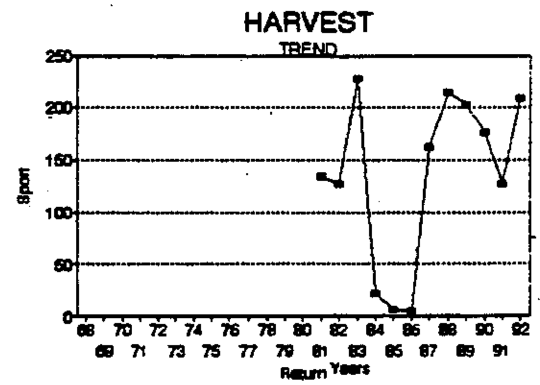
STOCK STATUS PROFILE for Pilchuck Winter Steelhead

STOCK ASSESSMENT

DATA QUALITY------> Good

Return Years	ESCAPE Total	HARVEST Sport		
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81	490	135		
82	657	127		
83	779	228		
84	930	22		
85	1706	6		
86	1644	5		
87	1416	162		
88	1424	215		
89	1650	203		
90	1124	176		
91	968	127		
92	1582	208		





AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Healthy

SCREENING CRITERIA

SPORT AND TRIBAL HARVEST OCCURS IN MIXED STOCK AREAS BUT CANNOT BE SEPARATED FOR EACH STOCK

SNOHOMISH -- SNOQUALMIE WINTER STEELHEAD

STOCK DEFINITION AND ORIGIN

Wild winter steelhead in the mainstem Snoqualmie River, Tolt River, Raging River, and tributaries are a distinct stock based on the of geographical isolation of the spawning population. At this time, it is assumed that the breeding units that use the various tributaries are not distinct, but when coupled with the mainstem spawners, comprise the aggregate Snoqualmie River stock.

As with other wild winter steelhead stocks in the Snohomish River system, run-timing is generally from November through April, and spawn-timing is generally from early March to early to mid-June.

Winter steelhead are native to the basin. While hatchery-origin (Chambers Creek) winter runs have been stocked into the system as fry or smolts for many years (smolts since 1956; fry terminated in 1930s), there is little contribution to the wild stock from hatchery fish spawning in the wild.

STOCK STATUS

The status of the stock is Healthy.

Stock status is based on spawner escapement and sport harvest. There is no downward (or upward) trend evident in escapement or sport harvest. The Snoqualmie winter steelhead stock is part of the Snohomish wild winter steelhead run. Spawner escapement of the wild run has generally met or exceeded the MSH escapement goal (see steelhead Overview report for Snohomish River system).

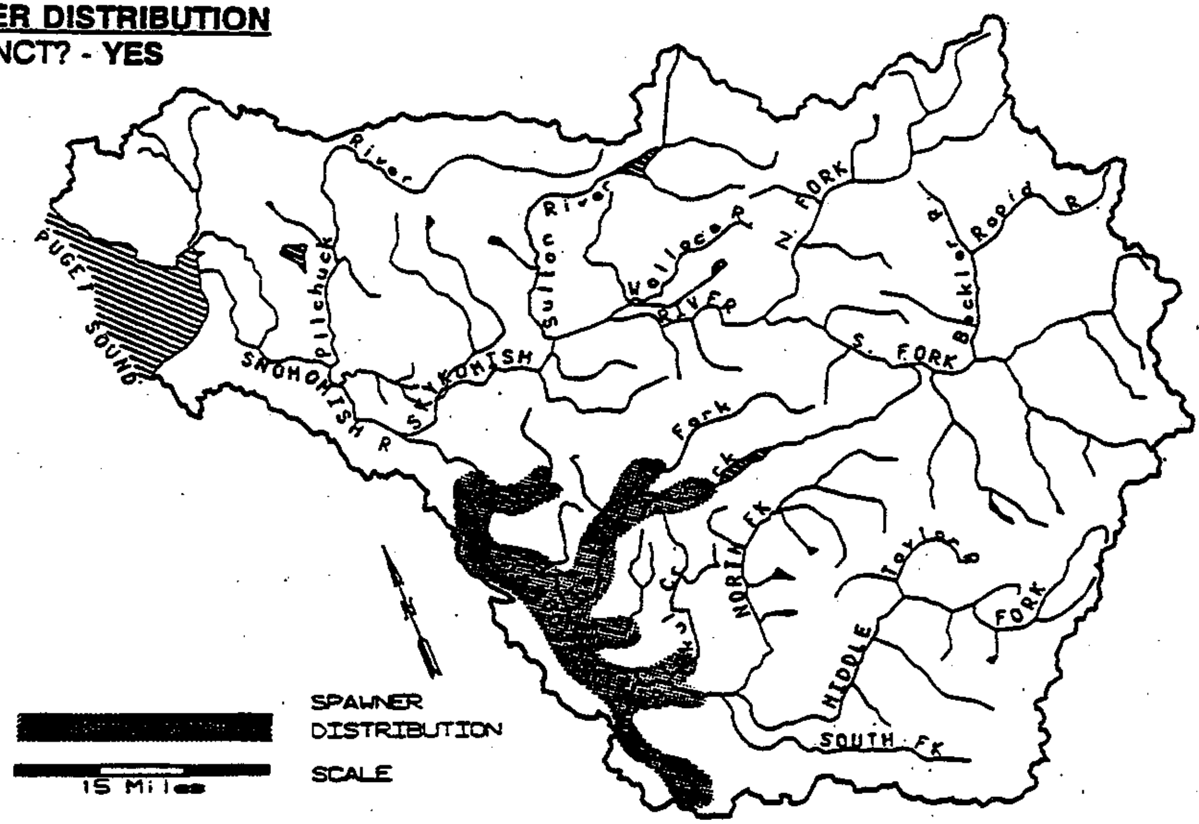
Harvestable surpluses are the rule rather than the exception, and special regulations are generally not required. These conditions occur despite strong commercial and sport fisheries in the Snohomish River and its estuary.

Data quality is excellent on wild spawner escapements, in-river sport harvest, and age and race breakouts from scales collected in the sport and tribal fisheries. Occasionally, however, poor spring water clarity in the Snoqualmie mainstem makes redd counts difficult. Thus, the escapements are conservative in a few years.

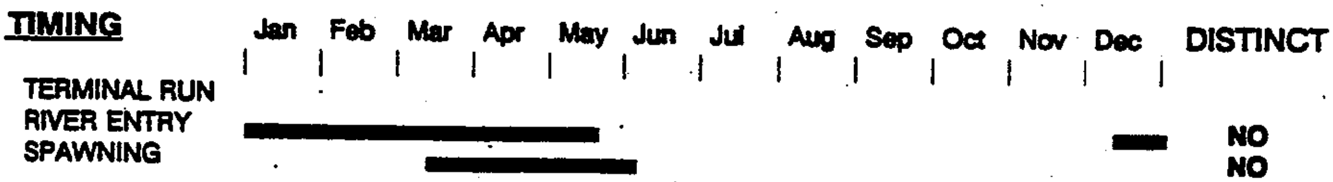
All tributaries historically used by significant numbers of steelhead are foot-surveyed from March 1 to end of spawning; the Snoqualmie and Tolt mainstems are surveyed by air from mid-March to end of spawning.

STOCK DEFINITION PROFILE for Snoqualmie Winter Steelhead

SPAWNER DISTRIBUTION
DISTINCT? - YES



TIMING



BIOLOGICAL CHARACTERISTICS
DISTINCT? - UNKNOWN

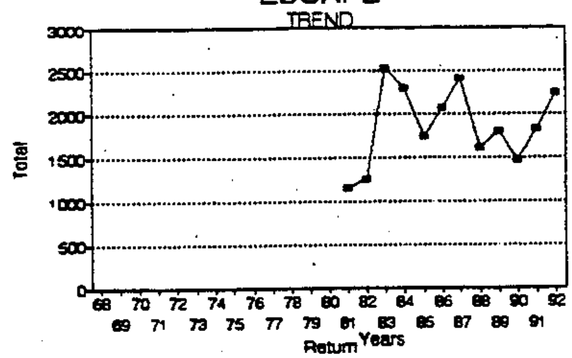
STOCK STATUS PROFILE for Snoqualmie Winter Steelhead

STOCK ASSESSMENT

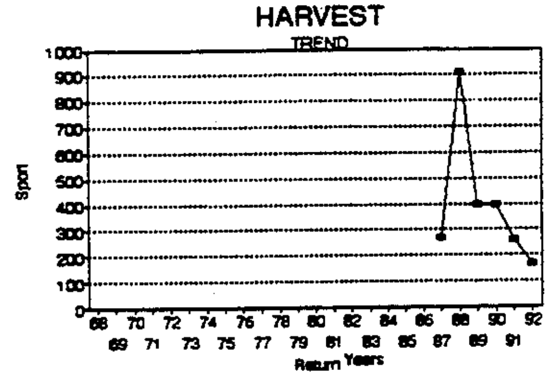
DATA QUALITY------> Excellent

Return Years	ESCAPE Total	HARVEST Sport		
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81	1167			
82	1261			
83	2536			
84	2305			
85	1748			
86	2070			
87	2420	270		
88	1610	912		
89	1810	398		
90	1478	397		
91	1832	257		
92	2246	169		

ESCAPE



HARVEST



AVERAGE RUNSIZE DISTRIBUTION

DATA NOT AVAILABLE.

STOCK SUMMARY

STOCK ORIGIN
Native

PRODUCTION TYPE
Wild

STOCK DISTINCTION
Spawning Distribution

STOCK STATUS
Healthy

SCREENING CRITERIA

SPORT AND TRIBAL HARVEST OCCURS IN MIXED STOCK AREAS BUT CANNOT BE SEPARATED FOR EACH STOCK

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GLOSSARY

ALLELE -- One of two or more alternative forms of a gene.

ANADROMOUS FISH -- Species that are hatched in freshwater, mature in saltwater, and return to freshwater to spawn.

CRITICAL STOCK -- A stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred.

COMPOSITE STOCK -- A stock sustained by both wild and artificial production.

CULTURED STOCK -- A stock that depends upon spawning, incubation, hatching, or rearing in a hatchery or other artificial production facility.

DENDROGRAM -- A graphic summary of the genetic relationships among populations. The horizontal distance at which the stock branches connect indicates the degree of similarity/dissimilarity. The longer the distance at which the branch points connect, the greater the average genetic differences among stocks.

DEPRESSED STOCK -- A stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.

ELECTROPHORESIS -- A process whereby charged molecules (such as enzymes and other proteins) are separated in an electric field.

ESCAPEMENT -- Those fish that have survived all fisheries and will make up a spawning population.

EXTINCT STOCK -- A stock of fish that is no longer present in its original range, or as a distinct stock elsewhere. Individuals of the same species may be observed in very low numbers, consistent with straying from other stocks.

GENE -- A specific unit of genetic material (DNA) that encodes the information for a single genetic trait.

GENE POOL -- The total variety and proportions of alleles within a population.

GENETIC DISTANCE -- A statistical measure that summarizes the detectable genetic differentiation among collections or stocks based on allele frequency differences across all gene loci screened. There are a variety of different genetic distance statistics in the published literature (e.g. Neil, Rogers, Cavalli-Sforza & Edwards), each with its strengths and weaknesses.

GENETIC STOCK IDENTIFICATION (GSI) -- A method that can be used to characterize populations of organisms based on the genetic profiles of individuals. The GSI process consists of a series of steps: (1) collect selected tissues from a representative sample of individuals from the population(s) under investigation; (2) develop genetic profiles for the individuals in each population by conducting starch-gel electrophoresis and histochemical staining using tissue extracts; (3) characterize each population by aggregating the individual genetic profiles and computing allele frequency distributions; and (4) conduct statistical tests using the allele counts characterizing each population to identify significantly different populations.

GENOME -- The total genetic composition of an individual. The complete genetic information possessed by an organism.

HEALTHY STOCK -- A stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock.

HYBRIDIZATION -- The interbreeding of fish from two or more different stocks.

LOCUS (LOCI) -- The site of a specific gene on a chromosome. Often used to refer to a gene and its alleles.

MIXED STOCK -- A stock whose individuals originated from commingled native and non-native parents, and/or by mating between native and non-native fish (hybridization); or a previously native stock that has undergone substantial genetic alteration.

NATIVE STOCK -- An indigenous stock of fish that has not been substantially impacted by genetic interactions with non-native stocks or by other factors, and is still present in all or part of its original range. In limited cases, a native stock may also exist outside of its original habitat (e.g. captive brood stock programs).

NMFS -- National Marine Fisheries Service.

NON-NATIVE STOCK -- A stock that has become established outside of its original range.

PRODUCTION TYPE -- The method of spawning and rearing that produced the fish that constitute a stock.

RM -- River mile.

SALMONID -- Any member of the taxonomic family Salmonidae, which includes all species of salmon, trout, and char. SASSI deals only with the Pacific salmon (chinook, chum, coho, pink, and sockeye) and with steelhead trout.

SASSI -- Salmon and Steelhead Stock Inventory.

SPAWNING POPULATION -- Synonymous with the term stock.

STOCK -- The fish spawning in a particular lake or stream(s) at a particular season, which fish to a substantial degree do not interbreed with any group spawning in a different place, or in the same place at a different season.

STOCK ORIGIN --The genetic history of a stock.

STOCK STATUS -- The current condition of a stock, which may be based on escapement, run-size, survival, or fitness level.

TREND -- The directional change in a time series data set.

UNKNOWN STOCK -- This description is applied to stocks where there is insufficient information to identify stock origin or stock status with confidence.

WDF -- Washington Department of Fisheries.

WDFW -- Washington Department of Fish and Wildlife.

WDW -- Washington Department of Wildlife.

WILD STOCK -- A stock that is sustained by natural spawning and rearing in the natural habitat, regardless of parentage (includes native).